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ABSTRACT

This study's major purpose was to identify school-related variables that affect the achievement of eighth-grade pupils in mathematics. The data are based on results of a basic skills test administered statewide in Tennessee. The main problem of the first phase of the research was to identify factors that may account for relatively large differences in mathematics achievement scores among schools that do not differ in their reading or language achievement scores. Thirty-two schools and sixteen feeder schools were selected for the study, with six of the buildings chosen for a pilot study. Variables studied in this investigation were classified into the following seven clusters: leadership, curriculum, instruction, school policies and practices, teacher, pupil, and parental/community. Many statistically significant differences between high and low-achieving schools are detailed in this report. The study cautions against drawing conclusions about the quality of the programs offered at any of the schools, but states that the data should point out areas of future research in which selected dependent variables can be isolated and cause and effect relationships determined. (MP)

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A Study of

School-Related Variables Influencing Math Achievement

In Selected Public Elementary Schools

A Summary Report

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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CHAPTER I

PURPOSE AND DESIGN OF THE STUDY

The Division of Research and Development of the Tennessee State Department of Education has completed the first phase of a multi-phase research effort to identify school-related variables that affect pupil achievement, as measured by the results of a basic skills test administered statewide to eighth grade pupils. The first stage of the research has been concerned with factors that affect achievement in mathematics. Schools that participated in this phase of the research were selected on the basis of results of the Basic Skills Test administered in April, 1979. Later phases of the research will deal with achievement in reading and in language arts. Mathematics was chosen as the subject of the first phase because pupil achievement throughout the state was less impressive generally than was achievement on other sub-tests.

Statement of the Research Problem

The main problem of the first phase of the research was to identify school-related factors that may account for relatively large differences in mathematics achievement scores among schools that do not differ in their reading achievement scores or in their language achievement scores.

As will be explained more fully later, the schools in the two sets of schools that were compared were selected by pairing on the basis of different

math scores, similar reading scores, similar language scores, and comparable school size. Because of the selection procedures used, the mathematics test scores of the higher-achieving schools collectively differed from those of the lower-achieving schools collectively. However, when the lower-achieving schools and the higher-achieving schools were treated as a single set of schools, their mathematics test scores did not differ from those of the population of all state schools. The two sets of selected schools did not differ from each other in reading scores or in language scores; and neither set differed from the population of state schools on either of these two measures of achievement.

Delimitations of the Study

The first phase of this research was delimited in at least four ways. First, it was, for the most part, delimited to those variables that are alterable by schools at the local level or by the reformulation of public policy. Previous research has demonstrated the influence of numerous non-school factors on educational achievement, and these factors are generally beyond the scope of this study. For example, we know that learning outcomes are affected by community variables such as wealth and tax base, types of parent occupations, level of parents' education, and so forth. But there is little or nothing a school can do to alter such variables beyond adapting strategies to lessen any of their inhibiting influences.

Second, the study was delimited to a study of those variables which previous research and experienced observers within the state suggest may influence mathematics achievement specifically. Although the variables studied are several, they have been grouped into sevel variable clusters as shown on the following page.

1) leadership

2) mathematics curriculum

3) instructional practices in mathematics

4) school policies and practices

5) teacher characteristics and behaviors

6) pupil characteristics and behaviors

7) community and parental variables (ones that may, to some extent, be alterable by school practices)

Third, the research was delimited to thirty-two selected schools containing eighth grade classes, plus any feeder schools. There is reason to believe these schools are representative of Tennessee schools in certain respects; they are not representative in other respects. As mentioned earlier and as will be elaborated later, there is reason to believe the selected schools are representative of schools statewide with respect to their achievement test scores. The types of communities they serve are not representative of Tennessee communities generally. With one exception, the selected schools serve rural communities and small towns. Patterns of test scores would have made it possible to include eighth grade schools in the hearts of Tennessee's larger cities. But because of the variety of school organizations, differences in school size, zoning and intra-city busing, the problems of identifying all the feeder schools and then isolating or controlling the many variables that surely exist among the many feeder schools would have rendered the research unmanageable. The importance of studying these schools, however, is of such importance that plans must be developed for doing so. Our present thinking is to treat the findings of the present research as hypotheses to be tested under conditions

in which selected variables can be controlled or isolated. In this kind of follow-up research, it should be possible not only to include schools in Tennessee's larger cities but also to subject the findings of this research to a more rigorous test than has been possible to date.

Fourth, schools were used as units of analysis. This was done because criterion measures, scores on the Basic Skills Test of April, 1979, were available for schools but not for classes. Moreover, pupils were in different classes, often different schools, during the 1979-80 school year when the research was carried out, from the ones they were in when the tests were administered. These constraints resulted from the planning of the research design ex post facto, six months after the administration of the Basic Skills Test. It became apparent even during the pilot study that on some variables the variation in pupil responses was much greater among classes within schools than it was between schools. Because of this effect, the investigation of certain variables included in the pilot study was not pursued in the main study. This was unfortunate but unavoidable under prevailing circumstances. There is little doubt that the effect of some variables that influence pupil achievement in mathematics has gone undetected by the constraint of using the school as a unit of analysis. In any follow-up investigation of variables that may influence mathematics achievement, it would appear that the planning of a research design that uses the classroom as the unit of investigation would be especially important.

Basic Research Design

The design of the research study called for the pairing of schools which differed widely in mathematics achievement scores but which were nearly

identical with respect to achievement scores in reading and also in language. The following mean scores, converted to Z-scores, for two schools illustrate the basis of the school pairings.

Mean School Achievement
Expressed in Z-Scores

Schools	Mathematics	Language	Reading
A	687	521	542
B	445	542	540

The Z-scores reported above were derived by assigning the state school mean on each sub-test a value of 500 and by assigning the standard deviation a value of 100. Hence, the school means may be interpreted in the same way as SAT scores. With Z-scores comparisons may be made among mean scores for various sub-tests, even though the sub-tests differed in the number of items contained. The means of the two schools for reading achievement, both above the state mean, do not differ statistically. The same is true of the means for language achievement. Their mean scores in mathematics differ markedly, however. Pupils in School A collectively scored at the 97th percentile rank among Tennessee schools, while those in School B scored at s the 29th percentile rank. Sixteen pairs of schools were identified whose achievement scores showed a pattern similar to the one illustrated above. Three of these pairs were used in a pilot study in November, 1979, to test the efficacy of the research instruments and research procedures. Following a refinement of research instruments and procedures as a result of the pilot study, the remaining thirteen pairs of selected schools were

the subject of the main research effort carried out in March and April, 1980.

Since research informs us that achievement in reading and language arts is more strongly influenced by socio-economic-cultural variables than is achievement in mathematics, there is reason to believe the research design controls to some extent, possibly to a considerable extent, for community variables that influence cognitive achievement generally. For the most part, the achievement of all the pupils in a given school was influenced in reading, in language arts, and in mathematics by the same set of teachers up to about the sixth grade at least. What factors account for the fact that pupils in two schools are so disparate in mathematics achievement while their achievements in reading and in language are virtually identical? And what factors account for the fact that in a given school pupils' achievement in mathematics is relatively much higher or much lower than the achievement of the same pupils in reading skills or in language skills? These are the main questions to which the present research efforts were addressed.

A Basic Assumption

One assumption underlying this investigation is of sufficient import that attention should be drawn to it at the outset. As mentioned earlier, the research was not planned until after achievement tests were administered, which fact necessarily resulted in the use of the school as the unit of analysis. The achievement measured by the tests did not occur during the time when the research was underway; much of it did not occur during the school year preceding the administration of the tests. Instead, the test, which was administered to eighth graders, measured achievement that had occurred incrementally over a period of several years. Therefore, in order to examine ex post facto the association between school-related variables

and mean achievement scores of schools, it was necessary to assume that the characteristics of individual schools have remained fairly stable over a period of about eight years.

For many schools the assumption may be reasonable; for some others it may not be. To the extent that this assumption is untenable, to that extent are the findings of this investigation invalid. This uncertainty makes it all the more imperative that the findings of this investigation be regarded as hypotheses to be tested under more rigorous conditions. It is believed, however, that operating under this assumption will more likely result in a failure to identify variables that have a positive effect on achievement than in a spurious association between school-related variables and pupil achievement.

A Word of Caution

Any association between mathematics achievement and certain school factors, identified as a result of this research, does not, in and of itself, establish a causal relationship between the two variables. The determination of cause and effect will require extended research in which selected dependent variables can be isolated or manipulated under carefully controlled conditions. This procedure will be necessary so that any effects on pupil achievement can be clearly attributable to a particular variable. Thus, caution must be exercised in drawing inferences from this present research. While certain inferences may be suggested, the data reported should be valuable mainly as a basis for identifying hypotheses to be tested more rigorously than has been possible to date.

Definition of Terms

As used in this report of research, certain terms are defined below.

Mathematics achievement: the achievement of eighth grade pupils with respect to twenty selected objectives of mathematics instruction as measured by the Basic Skills Test administered statewide in Tennessee to eighth grade pupils in April, 1979.

Reading achievement: the achievement of eighth grade pupils with respect to twelve selected objectives of reading instruction as measured by the Basic Skills Test administered statewide in Tennessee to eighth grade pupils in April, 1979.

Language achievement: the achievement of eighth grade pupils with respect to thirteen selected objectives of language instruction as measured by the Basic Skills Test administered statewide in Tennessee to eighth grade pupils in April, 1979.

Higher-achieving school: a school selected for inclusion in this research whose mean score on the mathematics achievement test was: (1) above the mean of all schools in the state and (2) significantly higher statistically than the mean score of the school with which it was paired in this study.

Lower-achieving school: a school selected for inclusion in this research whose mean score on the mathematics achievement test was: (1) below the mean of all schools in the state and (2) significantly lower statistically than the mean score of the school with which it was paired.

Set A schools: the collection of sixteen higher-achieving eighth grade schools, along with any feeder schools, that were selected for inclusion in either the pilot study or the main research study.

Set B schools: the collection of sixteen lower-achieving eighth grade schools, along with any feeder schools, that were selected for inclusion in either the pilot study or the main research study.

CHAPTER II

RELATED LITERATURE

Research literature was reviewed for two purposes. One of them was to identify specific variables subsumed under the seven variable clusters used in this study: leadership, curriculum, instruction, school policies and characteristics, teacher, pupil, and parental and community. Previous research findings pertinent to each of these seven clusters of variables are reported later under separate headings. The other purpose was to profit from the findings and experience of several other researchers in the planning of the research design and in evaluating certain limitations of the present study. Literature relating to considerations of research design is reviewed immediately below.

Background Considerations

School vs. Non-school Factors

Prior to about fifteen years ago, it was widely assumed that the kind and amount of pupil achievement was strongly influenced by school-related variables. Since the mid-1960's, salient research by Coleman, Jencks, their colleagues, and others cast serious doubt on this assumption. Coleman (1966) concluded that school-related factors have very little influence on a child's achievement that is independent of his social and family background.

After a thorough re-examination of Coleman's data, Smith (1972) and his colleagues reached the same conclusion. Smith reported that about 67% of the variance between schools in verbal ability was accounted for by the home background of a sample of ninth grade northern whites. Mayeske et al (1972) found that only 5% of the variance in composite achievement scores was uniquely attributable to school factors while 11% was due to home factors. The inference generally drawn from these research reports is that the effect of social, economic, and cultural variables is so powerful that variables that are distinctively school-related have relatively little influence on pupil achievement.

Other researchers have investigated the relationship between socio-economic status (SES) and pupil achievement. Coldiron (1975) reported a positive correlation between achievement in verbal and math skills and type of pupil's housing (from expensive private home to low-rental apartments) for pupils at both fifth and eleventh grade levels. Not only did pupils from higher cost housing excel on cognitive measures, they had more mature attitudes about the world of work and displayed better attitudes about themselves. White (1976) examined 489 analyses reported in 100 separate studies and found an average correlation of 0.25 between family SES and various indicators of educational achievement. The average of 41 correlations of SES and school grades was 0.24. And when SES was defined solely in terms of family income, the average of 19 correlations of family income and various measures of achievement was 0.32. Jencks (1972) has estimated a correlation of about 0.35 between family economic status and scores on various elementary and secondary school standardized tests. Begle (1979) reviewed 26 studies having to do with the influence of SES on pupil achievement in mathematics. The composite findings of these investigations led him to conclude, "Studies

of the relationship between this variable and mathematics achievement provide no surprises. Lower SES students do less well in mathematics." (p. 96) On the basis of a study done by the Tennessee State Testing and Evaluation Center entitled, Tennessee Looks at Its Schools: 1977-78, the investigators found that both the mother's and father's level of education were strongly and positively related to their child's achievement as measured by standardized achievement tests in several school subjects. Their evidence suggested to them that achievement in reading is more related to non-school and shared factors than to school factors alone. Evidence led them to hypothesize that mathematical computation is more dependent on school factors than on non-school factors, especially in the lower grades.

The belief that non-school factors are far more influential determiners of achievement than are school factors has recently been called into question. Virtually all the studies reported above used norm-referenced tests, either standardized tests of mental or verbal ability or standardized tests to measure achievement in specific school subjects, as criterion measures. Schools, rather than classrooms or individuals, were commonly used as units of analyses. Madaus, Kellaghan, Rakow, and King (1979) recently completed an extensive research program in the secondary schools in the Republic of Ireland. Their findings show rather convincingly that school characteristics and inputs can and do contribute far more to pupil achievement than has been thought since the advent of the Coleman report (1966). Through the use of the classroom as a unit of analysis, as well as curriculum-specific measures of achievement, Madus et al (1979) found that home background did not account for school achievement nearly to the extent that has been reported by other researchers. They write:

> ...it is clear that school-related differences and pupil performance must be disentangled from differences associated with outside influences such as home background. In doing this care must be taken to assess schools in terms of what they attempt to accomplish. The evidence presented in this study leads us to conclude that what goes on in schools is highly relevant to students' achievements. (p. 227)

Evidence from their research led Madaus et al (1979) to reach the conclusion that school variables that are the best predictors of achievement are those related to the climate or activities of the school rather than schools' static characteristics such as size, physical amenities, and teacher qualifications. They were led to believe that among the most important factors influencing pupil achievement are the academic demands of courses, pupils' concern for and commitment to academic values, the amount of time spent on study and homework, and a climate of high expectations on the part of both pupils and their teachers.

Sensitivity of Achievement Measures

A major part of the research carried out by Madaus et al (1979) had to do with studying the sensitivity of various measures of school effectiveness. These researchers compared pupil performance on standardized tests to their performance on public examinations, which in Ireland are geared specifically to school curricula. They found that tests designed to assess information and skills taught in specific courses are more sensitive to differences in school characteristics than are standardized tests, and their findings call into question the use of standardized tests as means for comparing the outcomes of different schools.

Evidence from the study of Madaus et al (1979) suggests that the studies reported by Coleman (1966), Jencks (1972), Smith (1972), and Mayeske (1972) may have found non-school variables to be more powerful predictors of

achievement than school-controlled variables because the standardized tests of mental and verbal abilities, which were used as their criterion measures, were more sensitive to outside school influences than to the specific inputs of schools. The Basic Skills Test used in Tennessee is not a standardized test of general ability; neither is it designed to assess broadly and fully the outcomes of specific curricula content. Instead, it is designed to measure pupil achievement on a common set of minimal objectives that transcend local district boundaries. A danger in assessing school effectiveness by means of an instrument of this type is that the test is not sensitive to measuring a variety of school-specific achievements that exceed those defined by the statewide minimum objectives. Not only is the test insensitive to many worthwhile achievements beyond those defined as minimal, use of the test may actually subvert them. In commenting on the drift toward a system of external testing that appears to be resulting from programs of minimum competency testing linked to high school graduation in several states, Madaus et al (1979) write, "Historically when tests set by an agency external to the school are the partial or sole determiner of future educational or career choices, or are used as positive incentives to allocate money, they exert a strong influence on what is taught, how it is taught, what pupils study, how they study, and what they learn."

What Unit of Analysis?

In their study of the sensitivity of measures of school effectiveness, Madaus et al (1979) used the classroom, rather than the school, as their unit of analysis. They argue that the classroom is a more appropriate unit of analysis than the school because it does not assume that all pupils within a school are exposed to the same conditions (teachers, curricula, resources, etc.). They cite recent studies that show that when within-school variance

is separated into variations between classes and between individuals, variations between classes are often substantial. Such a finding is consistent with certain data collected during the pilot study which was conducted in preparation for this main study. Our preliminary evidence strongly suggested that the pooling of data from a whole school in several cases obscured differences attributable to units within the school and hence failed to identify the differential effects of some potentially critical variables.

The authors of Tennessee Looks at Its Schools, 1977-78 emphasize the above point. They contend that reasons for the failure of previous research to identify variables that have positive effects on achievement have been that schools were treated as units of study and that differences within schools were not taken into account. Like the research reported in the previous reference, our research, described in this report, also suffers the limitations imposed by the necessity of using the school as a unit of analysis. Criterion measures were unavailable for classroom units, and resources for the sophisticated data collection methods that would be required at the classroom level were not available at the time the research program was planned. We hope, however, that this limitation may be mitigated to some extent by two procedures: (1) by the selection of two sets of schools for study for which mean scores in mathematics differed markedly but for which mean scores in reading, and also in language, differed not from each other or from the population of state schools; and (2) by focusing for the most part on those variables for which there was reason to believe their influence may be unique in affecting achievement in mathematics.

Literature Related to Variable Clusters

A primary goal of the literature search was to identify variables for which evidence pointed to a positive effect on mathematics achievement among elementary school pupils. Although several studies were reviewed that investigated the association between various dependent variables and general achievement, the findings of some of these investigations are sufficiently important and germane to the present study that they are included in the following review of related literature.

Leadership Variables

It is commonly held that school administrators do, or should, influence conditions, practices, and the climate of a school that affect pupil achievement. In a recent study sponsored by the Michigan Department of Education, Brookover and Lezotte (1979) studied eight schools, some of which had improved and some of which had declined over a three-year period in fourth grade assessment scores in both reading and in mathematics. They report that the improving and declining schools are distinguishable, among other things, by the role assumed by the principals. The role of the principals of the improving schools was that of a strong leader. In these schools, the principal was assertive in his/her instructional leadership, was a disciplinarian, and assumed responsibility for evaluating achievement in basic objectives. On the other hand, principals in the declining schools appeared to be more permissive and to stress informal and collegial relationships with teachers.

Coldiron and Skiffington (1975) asked Pennsylvania teachers selected for their study to respond on a five-point scale to six items concerning

their feelings about school administrators. Positive correlations were found between positive feelings toward administrators and pupil verbal and math scores at the fifth, eighth, and eleventh grade levels. Higher basic skills were associated with schools in which teachers perceived their administrators as supportive. Other studies, Coldiron and Skiffington note, have shown that teachers tend to be more innovative when they perceive their administrators to be supportive, a tendency which may lead to better teaching and ultimately to greater pupil achievement.

Begle (1979) reviewed 27 studies having to do with the relationship of various characteristics of in-service training programs to pupil achievement in mathematics. He noted a lack of any consistent research findings that provide information about topics on which teachers need help. He observes that in the absence of direction stemming from research, the only recourse is to base plans for in-service training on the perceived needs of teachers.

Curriculum Variables

Preschool Experience. Several research studies have sought to determine the effects on later achievement of nursery school or kindergarten experience. Begle (1979, p. 71) reviewed fifteen such studies and reported that, while the studies are not unanimous in their findings, they do suggest that pre-school experience leads to better mathematics achievement in the early grades. It is unclear, he observes from these studies, just how long this advantage lasts.

Haines (1960) studied two groups of children in Connecticut. One group was from a community without a kindergarten program. The second community, which had a kindergarten program that had been in operation for several years,

was similar to the first community with respect to size, location, socio-economic and ethnic composition, types of businesses and industry, and history. Tests of reading and math achievement were administered to all pupils in grades one through six. When it was discovered that pupils from the two communities were not comparable in mental ability, pupils were matched on the basis of mental ability to form pairs, reducing the initial population of over 800 subjects to 603. It was found that the group with kindergarten experience scored higher in reading than did the group without kindergarten experience, but the difference between the groups was not statistically significant. Math scores were higher in all grades for pupils with kindergarten experience, but they were significantly different (at the 0.01 level) from scores of pupils without kindergarten experience only in grades two and five. These findings suggest that the advantage in mathematics achievement that is associated with kindergarten persists up through the fifth grade at least. They further suggest that the effects of kindergarten experience may be stronger in influencing achievement in math than in reading.

Lazar and Darlington (1980) report the findings of the Consortium of Longitudinal Studies regarding the effectiveness of Head Start and similar preschool programs. Twelve investigators pooled data from their previous investigations, all carried out during the 1960's, and then designed a common follow-up study to analyze the effect of preschool experience on later school achievement. They reported:

> (1) Early education programs significantly reduced the number of children assigned to special education classes. This result held after controlling for the effects of children's IQ scores, sex, ethnic background, and family background. The benefit extended to all participants regardless of initial abilities or early home backgrounds.

(2) Early childhood programs significantly reduced the number of children retained in grade. The result held true when measures of early childhood characteristics and home background variables were controlled. All children benefitted, regardless of sex, ethnic background, early IQ, and home background.

(3) Early education significantly increased children's scores on fourth grade mathematics tests, and evidence suggested a trend toward increased scores on fourth grade reading tests.

Evidence from Coleman's study (1966), Mayeske's study (1967), and the Tennessee Study (Tennessee Looks at Its Schools: 1977-78) suggests that pupils who enter first grade with relatively high levels of development carry with them an advantage which, if sustained throughout the school years, would account for a fair amount of variation in achievement by the end of the high school years. The author of the Tennessee study observed that such variability in achievement at the twelfth grade level, while seemingly attributable to school factors, may actually be due to variation existing before school factors had an influence on the children.

For more than 17 years, Weikart (1979) and his colleagues have conducted a longitudinal study of children who participated in the Perry Preschool Project in Ypsilanti, Michigan. The project was designed to determine whether preschool experience benefits disadvantaged children. Children were selected for study on the basis of family (low) socioeconomic status and IQ scores of 85 or lower, as measured by the Stanford-Binet Intelligence Scale. Children entered the study in five successive, overlapping waves of about 25 children each, beginning in the fall of 1962. Each wave was divided by matching pairs into a group that attended preschool for two years and a group that did not. Each wave of pupils has been followed through grade eight. The Stanford-Binet was administered at the end of each school year up through grade four, and the Wechsler Intelligence Scale was given at the end of the eighth grade.

(It was judged to be more suitable for older children than the Binet.) The California Achievement Test was given at the end of each school year through the fifth grade and also at the end of the eighth grade. Teacher ratings of pupils' social and emotional maturity were collected annually through the third grade. By spreading the sample over five years and by analyzing each of the waves separately, the authors claim they were able, in effect, to replicate the study five times. They report the same positive effects for each of the five analyses, to wit:

(1) The IQ gains by the experimental group diminished until they matched those of the control group by the end of the third grade. Studies of Head Start children have demonstrated similar results.

(2) In the early grades, differences in achievement between the experimental and control groups were slight, but the differences increased over time. By the end of the eighth grade, the experimental group tested the equivalent of more than one full grade higher than the control group. The experimental group scored significantly higher than the control on all three sub-tests--reading, language, and mathematics.

(3) By the end of the fourth grade, more than twice (38% versus 17%) as many children from the control group as from the experimental group had been retained in a grade or placed in special education classes.

(4) Teacher ratings of children's social and emotional maturity consistently favored children with preschool experience up through the third grade, the last year for which ratings were made. Teachers reported preschool children to be less disruptive, less resentful of criticism, more honest and more friendly than children without preschool experience.

(5) A cost analysis of the project indicated that the savings realized by the reduction in special placements of the preschool children represented a 56% return on the original investment in the project. The authors estimate that the projected, increased lifetime earnings of the preschool children are substantially higher than the entire cost of providing the preschool education.

It may be that the positive effects of preschool experience may be considerably stronger for children from disadvantaged/low SES family backgrounds than for children from family backgrounds that are middle class or above.

Weikart (1979) observes that preschool experience is by no means a cure-all. For while the preschool children in his study excelled their counterparts without preschool experience by 1.2 grade equivalents by the end of the eighth grade, they were still one full grade equivalent behind the achievement expected of children with the same IQ's. It is possible that children from families of middle-to-higher SES backgrounds bring with them to school an advantage in language and reading (even if only having been read to) that makes preschool experience less influential on their later achievement. The preschool experience of these same children within their family in mathematics, however, is likely to be more limited than it is in reading or in language. This hypothesis, if confirmed, could explain why studies of preschool experience of middle class children demonstrate a more positive effect on mathematics achievement than for achievement in reading and language, whereas Weikart's study of disadvantaged children indicated strong positive effects for all three domains of achievement.

The findings from several investigations, reviewed above, point to an advantage of preschool educational experience that persists well into the elementary school, possibly up through grade eight or beyond. Several studies also indicate that the advantage of preschool experience may be stronger in its effect on achievement in mathematics than on achievement in reading.

Textbooks. Begle (1979) reviewed 118 research studies which evaluated the text materials of various mathematics curriculum projects and commercial publishers. On the basis of this review, Begle concluded that both project and commercial textbooks vary widely in mathematical content and structure.

He observed that any two textbooks differ on so many variables that it would be almost impossible to identify a specific variable as producing a specific difference. Begle commented, "without being able to know which variables make a difference, we do not know where to start to improve textbooks." (p. 73) By inference, neither do we know precisely what criteria to apply in evaluating math textbooks for adoption. The studies reviewed were unable to identify any particular textbook variable as being a strong or important indicator of pupil achievement. Begle suggested one reason for this finding may be that standardized tests, rather than curriculum specific tests, were used as criterion measures. Because the Basic Skills Test used in Tennessee assessed achievement on a relatively small number of skills that are undoubtedly basic in all state-adopted textbooks, it is unlikely that data on textbooks will distinguish higher-achieving schools from lower-achieving ones.

Curriculum Emphasis. Begle (1979) reviewed 36 studies dealing with what various researchers called "meaningful instruction." While there is no widely accepted definition of the term, it is often used to mean instruction that is designed to reveal meaning in the structure, the organization, and the inner relationships of the subject being taught. More than four-fifths of the studies reviewed by Begle reported that meaningful instruction is superior, in one way or another, to rote instruction. Begle suggested that future research should not concentrate simply on comparing meaningful versus rote instruction but that it should concentrate on ways of providing meaningful instruction and on the interactions between meaningful learning and pupil ability and/or maturity levels.

In commenting on his review of 28 studies of modern math programs, Begle (1979) noted, "The general pattern of such reported results as were

statistically significant sometimes showed somewhat of a decline in computational skills for students in modern programs, but at the same time, an increase in problem-solving achievement and in scores on other tests at higher cognitive levels." (pp. 68-69) He added, however, that it is difficult to derive a useful generalization because of the great variety of modern programs studied and because of the difficulty of defining just what constitutes a modern math program.

Begle (1979) also reviewed 54 studies having to do with acceleration. Several of them compared the relative merits of acceleration versus enrichment, and Begle contended that the results of the studies of this question are mixed. While he conceded that acceleration is often appropriate for talented pupils, he observed that research offers no guidance about the grade level at which it should begin. The results reported in Tennessee Looks at Its Schools: 1977-78 show that among selected schools in the state, those schools which have an accelerated program in one or more school subjects tend, with a few exceptions, to have higher scores on tests of general achievement than do schools having no accelerated programs. Data were not available regarding effects of accelerated math programs specifically.

Instructional Variables

Instructional Time. After reviewing 36 studies relating to the amount of time spent on math instruction and of various ways of allocating the time, Begle (1979, p. 129) concluded, "not surprisingly, more time usually results in greater achievement." In his study of characteristics of improving schools and declining schools, Brookover (1979) found that the improving schools emphasized basic reading and mathematics objectives and that they devote more time than do declining schools toward achieving these objectives.

Fisher (1979) and his colleagues at the Far West Laboratory in San Francisco began in 1972 an investigation of factors that affect pupils' academic productivity. They have given special attention to Academic Learning Time (ALT), which they define as the amount of time a pupil actually spends engaged in an academic learning task that can be performed with high success. Their research has involved 8,000 pupils and 300 teachers in over 100 schools and has concentrated on instruction and achievement in reading and mathematics. They measured ALT in three components: allocated time, engaged time, and success rate. They found that "the more time a student spends engaged in an academic task performed with high success, the more he or she is learning." Substantial variations in time allocated for instruction in particular school subjects were observed. It ranged from 25 minutes to 60 minutes a day among second grade classes and from 60 minutes to 140 minutes a day among fifth grade classes. It was not unusual for them to find that for two classes allocating the same amount of time for math instruction, pupils in one class spent twice as much time engaged in real learning as pupils in the other class. When one considers the wide variation in time allocated for math instruction and that only a portion of the allocated time is engaged in real learning, then, "When you add the fact that the average student is spending only half of his or her time engaged in high-success tasks, you begin to understand the reasons for differences in achievement in the basic skills." (Fisher, 1979, p. 3) Fisher contends that teaching behaviors account for a very important proportion of a pupil's learning. He commented,

> But we have heard so much over the past 10 to 15 years about kids not being able to learn because of their environment, or heredity, or a whole host of out-of-school factors. Well, schools do make a difference and, to a great extent, teachers are the reason. (p. 5)

The previous statement is not intended to blame teachers, Fisher adds. He concedes that teaching is a remarkably demanding job and is becoming increasingly more so. He suggests that rather than accuse teachers, educational leaders should work with them on practical programs to improve their school experiences. His major findings regarding instruction time are summarized below.

(1) Pupils whose teachers allocate more time to a particular school subject will achieve more than pupils whose teachers allocate less time to that school subject.

(2) Pupils who spend more time constructively engaged in a learning activity will achieve more than comparable pupils who spend less time.

(3) Pupils who spend more time than the average on high-success activities will achieve more than pupils who spend less time than the average. Older pupils (fifth grade and over), however, who are generally skilled at school learning need a smaller percentage of time on high-success activities.

(4) The use of aides, parent volunteers, or peer tutors increases the amount of interactive instruction time and should keep engagement rates high.

Pupil Grouping. Research into the effects of pupil grouping on the basis of ability or achievement has produced mixed results. Dewar (1963) found that intraclass grouping benefitted high and low achieving groups more than did total class instruction. Provus (1960) and Balow and Raddell (1963) reported that homogeneous grouping is especially effective for pupils with high IQ's. Savard (1960), however, concluded that decreased range grouping is more effective for lower-ability pupils than for upper-ability ones. The authors of Tennessee Looks at Its Schools: 1977-78 noted that higher standardized test scores tended to be found in schools that had more flexible groupings--that is, when pupils were assigned to different groups on the basis of their abilities in a particular school subject.

Numerous other studies indicate little or no effect by grouping on achievement. Koontz (1961), Mahler (1962), Middelson (1962), Bailey (1967, and Eddleman (1972) all investigated the effects of grouping at the elementary and secondary school levels. All of these investigators reported no significant differences in achievement between pupils grouped homogeneously and those grouped heterogeneously. Begle (1979, p. 106) reviewed 76 studies having to do with ability grouping. The composite findings led him to conclude, "for all but the most able students, it seems to make little difference whether they are grouped homogeneously or not." He observed that the research studies suggest that when grouping is used, it should be done on the basis of previous math achievement rather than on the basis of general ability, as measured by overall grade-point average or IQ.

Homework. Six studies that were reviewed all reported evidence for a positive effect on achievement by the assignment and completion of homework. Maertens and Johnson (1972) and Doane (1973) found achievement gains to be greater when homework was assigned than when it was not. The study reported in Tennessee Looks at Its Schools: 1977-78 found that higher standardized test scores were associated with more homework (up to 2-3 hours, total). Schools which assigned little homework tended to have lower scores. Peterson's (1970) evidence revealed that pupils receiving exploratory homework assigned three days prior to the teaching of a topic achieved better than did a group having no homework. Brinke (1966) studied seventh and eighth grade classes and concluded that supervised study is more beneficial than homework in improving achievement in math. There appears to be little doubt about the positive effect of individual study or drill. A main question appears to be whether it is more effective when supervised in school or when it is done outside of school.

Developmental Instruction and Drill. Research that has been reviewed suggests that in achieving a desirable balance between developmental instruction and drill in mathematics, the amount of drill or practice that is beneficial may be less than has been widely assumed. Ship and Deer (1960) compared groups in which 75%, 60%, 48%, and 25% of class time was spent on group developmental instruction while the remainder was spent on individual practice. They found that higher achievement was obtained on measures of computation, problem solving, and concepts when more than half of the class time was spent on developmental activities. This finding was confirmed when the study was replicated by Shuster and Pigge (1965). Zahn (1966) compared four different treatments, ranging from one which favored developmental over practice activities to one which favored twice as many practice activities as developmental ones. The results supported the conclusion that pupils learn arithmetic skills better by spending less time on practice and more time on developmental activities. The results held true for all three different ability groups that were part of the study.

Research done by Gay (1972) emphasized the importance of individualizing practice as much as possible. In her investigation, the index of optimal number of practice problems was determined for each pupil. Pupils were then divided into three treatment groups: those for whom the index number determined the number of practice problems, those who were free to choose the number of problems for practice, and those who completed practice on a fixed number of problems. Those who practiced on a fixed number of problems did less well than did the other two groups on long-term retention of mathematics learning.

Based on her review of literature, Suydam (1972) claims the research of the past few decades clearly demonstrates the superiority of meaningful instruction over rote instruction for inducing long-term retention of mathematical learning. In the short-run, she notes, learning derived primarily from rote memorization might be retained more efficiently but that the advantage diminishes with time. Callahan (1975) stresses that drill is an excellent way to consolidate mathematical learning, provided that conceptual learning occurs prior to the drill.

Miscellaneous. The remaining research reviewed that pertained to instruction had to do with self-paced instruction, the effects of review, the use of paraprofessional staff, and the effects of programmed instruction.

Schoen (1976) reviewed 76 studies comparing self-paced programs to traditional programs and found that over half of these studies revealed no significant differences between the two types of programs. He also found that 40 out of 55 studies reported no significant differences on affective criteria. Of the studies that reported significant differences, the results suggest that self-paced instruction was most effective with children in grades K-3 and least effective in grades 4-9.

Begle (1979) reviewed 14 studies having to do with the effects of providing for some kind of review after a certain amount of material has been covered before going further with new material. Various studies dealt with the amount, the kind, and the timing of review. Begle reports that these studies generally indicate that such review has a positive effect on achievement. He does not indicate whether the effect is stronger for some grades than for others or for some types of learning tasks than for others.

From Brookover's (1979) comparison of schools of declining achievement with ones of improving achievement, he noted that the declining schools in his study were characterized by their emphasis on paraprofessional staff and on the selection of pupils to place in compensatory programs. The declining schools also reported a greater emphasis on programmed instruction than did the improving schools.

School Policy and Practice Variables

School Attendance. The Tennessee study (1977-78) of achievement of selected grades in the state's public elementary and secondary schools reported that higher standardized achievement scores were associated with a thorough and uniform enforcement of the law regarding compulsory school attendance. Data from Coldiron and Skiffington's (1975) study of Pennsylvania schools indicate that school attendance is not related to cognitive achievement by elementary school pupils but that it is related positively to that of eleventh grade pupils. No other research studies were reviewed on this topic.

Promotion and Retention. The research literature on the effects of promotion and retention is fairly extensive. Space does not permit a preview of individual studies here. The summary of research, presented below, is an excerpt from a paper prepared for other purposes by the Tennessee State Department of Education. The summary is based on the reviews and research reports of Bocks (1977), Finlayson (1977), Gaite (1969), Godfrey (1972), Hess, Fritz, et al (1978), Jackson (1975), Koons (1977), Owens and Ranick (1977), Reinherz and Griffin (1970), Reiter (1973), Street and Leigh (1971), Walker (1973), and White and Lee (1975).

Research on the effects of promotion and retention supports a variety of

conclusions. Evidence is not definitive; whether it supports retention or promotion of low-achieving pupils appears to be related to the type of research design.

Declines in pupil achievement on standardized examinations originated during the mid-nineteen sixties, while grade retention generally disappeared from school practice in most districts during the late nineteen thirties and early nineteen forties. Thus, the chronological basis for linking retention and repetition with academic achievement largely disappears.

Some studies have shown that retention produces adverse effects on pupil self-concepts, motivation, and attitudes. One study (Finlayson, 1977), a rather thorough one, showed a slight improvement in self-concepts among non-promoted pupils.

Numerous studies suggest that extreme policies--either automatic promotion or a strict policy based only on academic achievement--fail to solve problems for poor achievers. The best approach appears to be one which is flexible and is based on a case-by-case consideration of academic problems and social and emotional problems of individual pupils.

Nongraded, continuous progress programs seem an appropriate response to the problems of slow- or low-achieving pupils, since it removes the conflict between the graded structure of schools and pupils' individual differences.

The ages at which pupils enter first grade appear to exert a far greater influence on academic achievement than does retention. Some investigators suggest that academic difficulties in elementary children may be due as much to lack of learning readiness as to any other factor.

School Atmosphere. From their study of Pennsylvania schools, Coldiron and Skiffington (1975) reported that in schools where teachers perceive fewer problems, almost all the cognitive scores were higher. Their analysis of data indicated that this effect was somewhat, although not completely, independent of the socioeconomic status of the community. The association between the absence of problems in school, as perceived by teachers, and higher scores on basic skills tests held true at all grade levels.

Teacher Variables

Research studies related to teacher variables are reviewed in two categories: variables that are relatively static and those having to do with teaching behaviors and attitudes.

Static Characteristics. Coldiron and Skiffington (1975) found no relationship between pupil achievement and either teacher age or number of years in present teaching position. They also found that level of teacher education, from less than the bachelor's degree to the doctorate, was unrelated to pupil achievement at the fifth grade level. It did relate positively, however, with pupils' verbal skills, but not mathematical skills, at the eleventh grade level. They noted that a cause-effect relationship was not evident. Begle (1979) concluded on the basis of his review of a large number of studies that teacher effectiveness, as measured by pupil achievement, is not strongly associated with number of years of teaching, highest academic degree, math credits beginning with calculus, or number of credits in methods of teaching mathematics. The latter variable was the strongest indicator of all these variables; but it had a significant positive relationship to math achievement in only 24% of the research studies, and it had a negative

relationship in 6% of the studies. Obviously, no relationship was found in over two-thirds of the studies reviewed.

Begle (1979) reviewed 17 studies of the effect of teachers' knowledge of mathematics on pupil achievement and conducted an investigation of his own. He suggested that a drastic revision is needed in the widely held belief that the more a teacher knows about his subject matter, the more effective he will be as a teacher. He found that additional math courses beyond the beginning of calculus contributes nothing to improving the effectiveness of elementary school teachers in teaching math. He wrote, "once a teacher reaches a certain level of understanding of the subject matter, then further understanding contributes nothing to student achievement." (p. 51)

Teaching Behaviors and Teacher Attitudes. The National Longitudinal Study for Mathematics Abilities (Begle, 1979) found that none of the following has a strong influence on teacher effectiveness, as measured by pupil achievement: teacher concern with insight and understandings, as opposed to rote; empathetic concern for the social and emotional development of pupils; satisfaction with and interest in teaching; nonauthoritarian approach, as opposed to strict disciplinarian; the extent to which teachers like and value math; and stress on creative processes in teaching, as opposed to memory tasks. The National Longitudinal Study also found that elementary school teachers generally do not dislike math and are not afraid of it. Their attitudes were, at worst, neutral. Based on his survey of 31 research studies, Begle (1979) reported that teachers' opinions about mathematics, about students, and about themselves show rather low, positive correlations with pupil achievement. He concluded that teacher attitudes seem to have little effect on pupil achievement. On the other hand, Phillips (1973) found that the type of

teacher attitude a pupil has encountered during the past two or three years, and especially the most recent teacher's attitude, is significantly and positively related to a pupil's achievement at a given time.

Research by Borich (1979) demonstrated that math achievement is improved where the teacher is supportive of each pupil, especially less successful ones, and when teachers consistently wait for and help to draw out responses before moving on from one pupil to another. Some studies (Borich, 1979; Brophy, 1974) have demonstrated the importance of public acknowledgment of success, especially for low achieving pupils, as they experience success or progress in group situations. An implication is that teachers should be liberal and regular with positive reinforcement for risk-taking. Since one characteristic of a low-self concept is a reluctance to take risks, teachers should provide a climate in the classroom in which risk-taking is perceived by pupils as acceptable. Braun (1976) suggests that both pupils and teachers can learn much from incorrect responses.

The Pennsylvania school study (Brookover, 1979) produced interesting findings with respect to teacher expectations. The staffs of schools in which achievement had been improving in recent years tended to believe that all pupils can master basic objectives, while staffs in schools where achievement had been declining tended to regard some pupils' abilities as being so low that their mastery of basic objectives would be impossible. Teachers and principals in the declining schools felt there was not much they could do to influence the achievement of their pupils. They spent less time in direct instruction, and they tended to place responsibility for skill learning on parents or on the pupils themselves.

The research studies reviewed above seem to indicate that static teacher characteristics (e.g., age, experience, educational level, knowledge of math) are much weaker indicators of pupil achievement than they have previously been thought to be. Indeed, numerous kinds of teacher attitudes may be less influential than has been thought. It may be that strong indicators of pupil achievement are the kind of expectations teachers have for pupil performance and the particular teaching behaviors that communicate those expectations to pupils.

Pupil Variables

Research findings on the effect of pupil attitudes on their achievement appear to be fairly consistent. Neal (1969) and Aiken (1976) both assert that a low but significant positive correlation is usually found between pupil attitudes and achievement. Aiken reports that this result has been found at the elementary, secondary, and college levels, in other countries as well as in the United States, and with minority pupils within the United States. From his survey of 93 different research studies relating to pupil attitudes, Begle (1979) concluded that there is "a significant positive correlation between (pupil) attitudes and achievement. Positive attitudes go with greater achievement. The relationship, however, is not as strong as many seem to believe, and it does not show up in every study." (p. 87) The direction of causality is still unclear. We do not know whether positive attitudes promote achievement or whether they are the result of achievement.

Many of the 93 studies surveyed by Begle (1979) assessed pupil attitudes toward math by one means or another. Contrary to popular opinion, math is not the most strongly disliked school subject. Indeed, the attitude of the

average pupil toward math is close to neutral. According to Begle, when elementary school pupils are asked to rank order school subjects according to their likes and dislikes, mathematics generally ends up in the middle.

One study came to our attention having to do with the effect of peer attitudes on achievement. The results reported in Tennessee Looks at Its Schools: 1977-78 indicate that general achievement is higher in schools in which peers admire and respect high achievement in others and is lower in schools in which high achievers are chided by their peers.

Parental Variables

Because non-school factors were not central to this study, the literature review on parental variables was cursory.

In their study of Pennsylvania schools, Coldiron and Skiffington (1979) found a positive correlation between parental attitude toward school, as perceived by pupils, and verbal and math achievement at the fifth, eighth, and eleventh grade levels, the only grade levels studied. They reported that pupils do much better in school when they perceive their parents as being supportive of the school. When they feel there is a mutual support between school and home, they have better attitudes toward school and their achievement is greater.

Coldiron and Skiffington (1979) also found that pupils who have more favorable attitudes toward their home conditions tended to do better on both verbal and math achievement tests at the fifth and eighth grade levels. The results were the same for both low and high socioeconomic groups. The authors contend that this finding is especially important since the indicator is independent of socioeconomic status.

Some effects of parental variables were reported in Tennessee Looks at Its Schools: 1977-78. That study found that higher standardized achievement scores tended to be associated with schools in which teachers feel that parents take an interest in their children's school work and lowest in schools in which teachers feel "the parents don't take enough interest in their children's school work." Among selected Tennessee schools, the highest achievement scores in grades four, eight, and twelve (the only grade levels studied) were associated with parents who expected their children, according to their childrens' perceptions, to rank above the middle of the class in achievement. The association was stronger for this expectation than for the expectations that their children be one of the best, in the middle, or just good enough to get by.

CHAPTER III

THE PILOT STUDY

In preparation for the main thrust of the research effort, carried out in March and April of 1980, a pilot study was conducted during November and December, 1979. A full report of the pilot study was prepared by the Division of Research and Development of the Tennessee State Department of Education, entitled "Report of the Pilot Study: A Study of School Related Variables Influencing Achievement in Basic Skills in Tennessee Public Schools, Part I, Achievement in Mathematical Basic Skills" (February 1, 1980). A summary of only the principal outcomes of the pilot study are reported here.

Purposes of the Pilot Study

The main purposes of the pilot study were to:

(1) check the efficacy and adequacy of the research instruments;

(2) identify unanticipated problems with proposed research procedures;

(3) identify unanticipated problems that might be connected with analyzing data in the particular form in which they were collected;

(4) obtain better estimates of the various resources that would be required in collecting data in the main study; and

(5) identify variables or hypotheses, not previously identified, that would merit further investigation, based on the experience of the field staff in observing first-hand the conditions and practices within the pilot schools.

It was anticipated that, as a result of the pilot study, it would be necessary to revise research instruments and to modify some of the plans for

collecting, treating, and analyzing data prior to the commencement of the main study.

Procedures Used in the Pilot Study

Following a two-day meeting at the State Department of Education in Nashville to prepare for the pilot study, a total of nine specialists from the various district offices visited the six schools that participated in the pilot study in two-member teams. One of the three mathematics specialists was a member of each visiting team. After making all preliminary arrangements, a team visited in each school for a period of two days.

After meeting with the principal and faculty of the school to explain the purposes of the research study and of the pilot study, the team made arrangements for all teachers of mathematics to respond to two questionnaires, a brief one for which identification of the teacher was requested, and a longer, anonymous questionnaire. Arrangements were also made for the pupil questionnaire to be administered by teachers to all pupils in grades five through eight. In addition to collecting information by means of these questionnaires, the field observers recorded other pertinent information on a pre-prepared "Field Observer's Guide," basing their observations on classroom visits during the two days and on information and impressions gleaned from discussions with pupils, teachers, principals, supervisors, superintendents, and in some cases, from inspection of school records.

Following the collection of data in this manner, all questionnaires were returned to the Division of Research and Development, State Department of Education. During January, 1980, questionnaire responses were transferred to

master sheets, tabulated, and the data were analyzed. Analyses were carried out through correlation coefficients, t-tests, and chi-square tests.

Major Findings of the Pilot Study

Only the major findings that emerged from the analysis of data from the pilot study are presented below. Summaries of data, detailed information, and minor outcomes are contained in the full report referred to in the first paragraph of this chapter.

It must be kept in mind that the findings of the pilot study can be considered as no more than tentative. Findings were based on data collected from 57 teachers and 621 pupils in only six of the 32 schools selected for participation in the current research effort. The remaining 26 schools, and their 16 feeder schools, furnished data for the main study. The numbers of teachers, pupils, and schools involved in the pilot study were too small and limited in representativeness to warrant general inferences with respect to substantive findings. The pilot study, nevertheless, was highly worthwhile in accomplishing the previously mentioned purposes. At best, the findings of the pilot study pointed to some hypotheses that deserved further investigation, to some that did not warrant further study within the context of this study's research design, and to some hypotheses that were not identified at the beginning of the study.

Findings Related to Leadership Variables

Compared with teachers in lower-achieving schools, those in higher-achieving schools:

(1) expressed more strongly a belief that classroom teachers should be

involved in planning the goals, objectives, content, and scope and sequence of the mathematics program;

(2) expressed a stronger belief that in-service programs should be designed and carried out to provide the amount and kind of help that teachers really need in order to improve the instructional program in mathematics;

(3) reported a greater prevalence of effective in-service training in their schools or school systems;

(4) believed that administrators and supervisors in their schools attach greater importance to the achievement of each and every child in mathematics than do their counterparts in the lower-achieving schools.

Findings Related to Curriculum Variables

Compared with teachers in the lower-achieving schools, those in the higher-achieving schools:

(1) assigned higher ratings to the goals of teaching the applications of mathematics and to developing pupils' alertness to reasonableness of results, while not differing with them in rating any of the other nine selected goals of instruction;

(2) believed the math programs in their schools give greater stress to the practice and repetition needed to develop basic skills;

(3) believed their schools do a better job in challenging fast-learning pupils;

(4) believed their schools provide more adequately for the needs of slow-learning or low-achieving pupils;

(5) believed more strongly that the math programs in their schools strike a desirable balance between "modern math" and "traditional math;"

(6) were not nearly as divided in their opinions regarding the appropriate

roles of "modern" and "traditional" math in their school programs.

Findings Related to Instructional Variables

Compared with teachers in the lower-achieving schools, those in the higher-achieving schools:

(1) reported that on the average they allocate 27% less time for math instruction, a difference that is significant at the 0.05 level;

(2) generally expected pupils to spend less time with homework, although the difference in expectations was not statistically significant;

(3) reported that they more often check homework personally and that they less often permit pupils to correct each others' homework;

(4) reported that they less often assign the same math homework to the entire class and that they more often give different homework assignments to different individuals and/or small groups, based on different pupil achievement levels;

(5) expressed a stronger belief in the value of small group instruction, as opposed to undifferentiated instruction, in contributing to pupil achievement in mathematics;

(6) reported that math instruction is more frequently carried out in their schools with small groups, organized on the basis of individual achievement levels, as opposed to instruction designed for the entire class;

(7) reported a greater availability of supplementary instruction materials in a variety that is appropriate for the range of achievement levels among their pupils;

(8) expressed a stronger belief in the value of regular discussions and firm arrangements among teachers at different grade levels as a means of avoiding gaps and unnecessary repetition in the math program; and they expressed less satisfaction with existing arrangements of this kind in their schools;

(9) believed teachers should have or exercise greater freedom in selecting the content and in planning the instructional sequence of the year's math program, based on the teacher's assessment of pupil achievement status in relation to local objectives; whereas teachers in the lower-achieving schools tended to be more content to accept the adopted textbook as a basis for determining content and instructional sequence.

Findings Related to School Policies and Practices

(1) Teachers in lower-achieving schools were more dissatisfied with their schools' promotion practices than were teachers in the higher-achieving schools; the former felt more strongly that, except for pupils in special education programs, pupils should not be promoted from one grade to another unless their achievement in math is at, or very near, grade level.

(2) Higher and lower-achieving schools were not distinguishable on the basis of the proportion of all pupils who are retained for one or more years in the same grade level. However, the incidence of grade retention was higher in the first four grades among the higher-achieving schools and was higher in grades seven and eight among lower-achieving schools.

Findings Related to Teacher Variables

(1) Teachers in higher and lower-achieving schools did not differ statistically with respect to: number of years of high school math completed; number of credits earned in college mathematics; number of credits earned in methods of teaching math; recency of last math course completed; certification status; total teaching experience; the number of years experience in teaching math in grades K-8; college degree status; the field of study in which their most advanced degree was completed; or dissatisfaction with the particular grade level they were teaching. While the differences were not statistically

significant, teachers in the lower-achieving schools reported: having completed slightly more high school courses in math; slightly fewer college courses in basic, general, or introductory math; considerably more credits earned in college algebra, geometry, trigonometry, or more advanced math courses; having earned more credits in methods of teaching math; a slightly lesser incidence of inappropriate certification for present teaching assignment; slightly less total teaching experience as well as slightly less experience in teaching mathematics; having completed more than twice the percentage of master's degrees as teachers in the higher-achieving schools.

(2) Teachers in higher-achieving schools tend more to the view that achievement problems are correctable, while teachers in lower-achieving schools tend more to the view that little can be done to improve the achievement of pupils who have low mental ability or low aptitudes for learning math.

(3) Teachers in higher-achieving schools expressed a greater interest in teaching math than did teachers in lower-achieving schools.

(4) To a greater extent than pupils in lower-achieving schools those in higher-achieving schools perceived that their teachers: give them help and encouragement when they do not do well at something; provide public acknowledgment for tasks well done; more often give pupils time and help them think through their responses to a question before referring the question to another pupil; ask questions in class about things pupils have memorized; are just as interested in <u>how</u> pupils solve math problems as in their getting right answers; enjoy teaching math; like them even when they do not do their very best. The differences in pupils' perceptions of all of these teacher behaviors were statistically significant.

(5) To a greater extent than pupils in higher-achieving schools, those in lower-achieving schools said they could do better in math if they knew their teachers really wanted them to.

Findings Related to Pupil Variables

(1) More teachers in higher-achieving schools reported that most of their pupils are sufficiently motivated to learn mathematics than was the case with teachers in lower-achieving schools.

(2) Pupils in higher-achieving schools did not differ from those in lower-achieving schools on mathematics self-concept scores. Incidental evidence indicated that considerable variation on math self-concept scores existed among classes within all schools. This observation suggests the hypothesis that children's math self-concept scores may be influenced to a considerable extent by the math teacher of the most recent several months. To test this hypothesis, it would be necessary to use the classroom rather than the school as the unit of analysis.

(3) Significantly more pupils in higher-achieving schools than in lower-achieving schools reported that their classmates respect and look up to kids who do well in math; whereas, more pupils in lower-achieving schools than in higher-achieving schools reported that their classmates look down on kids or make fun of them when they do well in math.

(4) Pupils in higher-achieving schools expressed stronger interests in math as a school subject than did pupils in lower-achieving schools.

(5) A significantly greater proportion of pupils in higher-achieving schools had preschool experience, nursery school as well as kindergarten, than was true of pupils in lower-achieving schools.

Findings Related to Parental Variables

(1) Teachers in higher and lower-achieving schools did not differ in

their perceptions of the extent to which parents encourage their children to achieve in math or the extent to which parents support and reinforce teachers' efforts to bring about pupil achievement.

(2) Although differences were not statistically significant, pupils in higher-achieving schools generally reported their parents to be more interested in their math achievement than did pupils in lower-achieving schools.

(3) Pupils in higher-achieving schools believed their parents expect more of them in math achievement than did pupils in lower-achieving schools.

Evaluation of the Pilot Study

Conducting the pilot study was a highly valuable preparation for the main study. The accomplishments of the five purposes of the pilot study, previously identified on page 36, are discussed below.

Experience from the pilot study indicated that the research instruments were basically adequate but not as efficient as they should be. For one thing, time for administration was too great. Secondly, we learned that the variety of response modes, especially on pupil questionnaires, should be reduced. Consequently, the revision of questionnaires was undertaken with the aims of reducing the number of items and the variation in response modes as well as of improving word meaning and sentence clarity. The latter task was based on pupils' responses to the questionnaires; they circled words and placed asterisks before sentences whose meanings were unclear to them. The questionnaires used in the pilot study sought certain information, the analysis of which suggested that further investigation would not be productive in explaining differences in pupil achievements. Among this type of information were some static characteristics of teachers such as degree status, years of teaching experience, and

recency of math courses. Among the sections omitted from the revised teacher questionnaire were: a section on goal ranking; a ranking of school subjects according to teachers' interest in teaching them; a ranking of school subjects according to teachers' perceived difficulty in teaching them.

The pilot study did not reveal any major unanticipated problems with the research design. It did confirm, in our minds at least, what was already suspected, namely that the use of the school, rather than the classroom, as a unit of analysis would obscure the effect of some variables. In our opinion, the masking of the effect of variables by the choice of the school as a unit of analysis was undoubtedly operative for mathematics self-concepts and for the set of items entitled "Me and Life," which was designed to assess pupils' expectations as to whether they or circumstances beyond their control determine the course of their destiny. Because we were committed by circumstances to using the school as a unit of analysis in the main study, these two sections were not included in the revised pupil questionnaire.

The pilot study did not reveal any major unanticipated problems with the analysis of data in the particular form in which they were collected. The number of teachers in the pilot study was such that in some chi-square analyses the cell frequencies were insufficient for analysis. But the number of teachers who would contribute to the main study would be sufficiently large to avert this problem. Analysis of the pilot study data indicated the desirability of asking each teacher to identify the specific grade or grades in which he/she teaches math this year. Several potentially fruitful analyses of data would be impossible without this information.

The experience with the pilot study afforded accurate estimates of the resources that were needed for collecting data for the main study. Our

estimates of times for briefing teachers, for teachers to complete questionnaires, and for teachers to administer questionnaires to pupils were highly accurate. Our estimates of the number of district office staff members, the amount of their time involvement, and the duration of their school visits were likewise accurate. As a result, we were not caught short on resources; neither were resources squandered.

The experience of the pilot study suggested few hypotheses not previously identified. It suggested that checking on differences in school attendance by pupils in higher and lower-achieving schools might be worthwhile. Instead of asking teachers to rate various characteristics of administrators and supervisors collectively, as was done in the pilot study, the revised questionnaire contained items pertaining to the instructional leadership roles of principals and superintendents separately. Although data on class size were not collected systematically in the pilot study, certain information came to our attention that suggested that differences in average class size might exist between the two sets of schools. Accordingly, data on class size were collected systematically in the main study.

CHAPTER IV

PROCEDURES USED IN THE RESEARCH

This chapter deals with the criteria and processes used in the selection of schools for study, pupil achievement characteristics of the selected schools, the variables that were investigated, and the procedures used in the collection of data.

Selection of Schools

In order to match schools which differed markedly in mathematics mean scores but which had nearly equal mean scores in reading and also in language, a list was first compiled of those public schools in the state for which mathematics scores were appreciably higher or lower than their scores for either language or reading. Several preliminary procedures, described below, had to be completed prior to the compilation of such a list.

The mean scores for each school were reported by the state testing service as the average number of items answered correctly on each of four sub-tests. Since the various sub-tests consisted of different numbers of items, a school's mean scores on the sub-tests could not be compared directly with each other. To make such comparisons possible, all raw mean scores were converted to Z-scores, arbitrarily using 500 as the state mean and 100 as one standard deviation. This standard deviation is a measure of the deviation of the mean

scores of 690 schools from the state mean on any particular sub-test. Thus, a Z-score of 650 on a given sub-test indicates that a school's average score was 1.5 standard deviations above the state mean for that sub-test and would place the school at the 93rd percentile rank (top 7%) among the state's public schools. Similarly, a score of 350 would be 1.5 standard deviations below the state mean and would place a school at the 7th percentile rank among 690 state public schools. Under this Z-score system, virtually all (99.7%) scores fall within the range of 200 to 800. Table 1 below shows the percentage of schools whose mean score may be expected to be less and greater than certain Z-score values, assuming a normal distribution of school means.

Table 1

Z-Scores and Percentile Ranks

	Percentage of Schools Whose Scores Were	
Z-Scores	Less Than	Greater Than
300	2.3%	97.7%
350	6.7	93.3
400	15.9	84.1
450	30.8	69.2
500	50.0	50.0
550	69.2	30.8
600	84.1	15.9
650	93.3	6.7
700	97.7	2.3

A form was developed for recording the mean Z-scores of each of the sub-tests. A separate sheet was used for recording the individual school mean scores for each of the 148 school districts in the state. These sheets did not identify school systems or individual schools by name; they were

identified only by state-assigned code numbers. This fact is mentioned to stress the point that the identity of schools was not known to those persons involved in the pairing and selection process until the process was virtually completed. Hence, no effort was made to exclude or to include any school from the study except on the basis of objective criteria to be described shortly.

As a first step, a list was prepared of all schools for which the mean score in mathematics differed from the mean score in either language or reading by 100 points (Z-scores) or more.* From this initial list, all schools were deleted in which the number of eighth grade pupils who took the Basic Skills Test was less than 20, a number that approaches the normal population of one classroom. After these deletions, the resulting list consisted of 43 schools.

An attempt was then made to match each of these 43 schools with one or more of the other 600 or more schools which reported test results for 20 or more eighth grade pupils. Potential matches were identified if: (1) the reading scores from the two schools were similar; (2) their language scores were similar; (3) their mathematics scores differed by approximately 100 points or more. In some instances it was possible to match as many as ten schools with a given school. From the pool of possible matches for a given school, the one was chosen that most closely satisfied four requirements

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*Schools were not matched on the basis of spelling scores partly because the number of items on the spelling test was relatively small (20) and was based on only five objectives. Also, the state mean and standard deviation for spelling scores, as well as the probable error of measurement, were such that it was believed that the spelling test did not reliably discriminate among schools' achievement nearly as effectively as did the tests for language and reading achievement.

collectively: (1) a minimum difference in reading scores, (2) a minimum difference in language scores, (3) a maximum difference in mathematics scores, (4) and a minimum difference in the number of eighth grade pupils taking the Basic Skills Test. The latter criterion was applied so that the two members of a pair of schools would be comparable in size. Following this procedure, a pool of about 25 school pairs was obtained. From this pool of school pairs, several were deleted so that the school pairs selected for the research study met the criteria described below.

Criteria Used in the Final Selection of School Pairs

The pairs of schools matched for inclusion in the research study were chosen on the basis of the following criteria.

(1) The reading scores of the two matched schools must not differ from each other, as determined by t-test, at the 0.05 level of confidence. The same criterion was applied to the schools' language scores.

(2) The mathematics score of the school-pair member that scored lower in mathematics must be below the state mean of 500, and the mathematics score of the school-pair member that scored higher in mathematics must be above 500.

(3) The difference between the mathematics scores of the two schools of a pair must be 100 points (Z-scores) or greater as well as be statistically different from each other, as determined by use of a t-test, at the 0.05 level of confidence.

(4) The ratio of the numbers of eighth grade pupils taking the test in the Spring of 1979 in the two schools must not be greater than two to one.

(5) In cases where all grades below grade nine are not housed in the

same building, all feeder schools must be identifiable and sufficiently small in number to be manageable in the research effort--usually no more than two feeder schools which must be located within the same local community. This criterion, of course, was applied after the name-identity of the schools became known.

The application of these criteria resulted in the selection of 16 pairs of schools, the scores for which are shown in Table 2 on page 51. The identities of the 32 target schools, along with their feeder schools, are presented in Table 3 on page 52. Four minor and insignificant exceptions to the above criteria were made in order to include four pairs of schools that otherwise satisfied criteria.

Exceptions in the Application of Selection Criteria

The exceptions made in the application of the selection criteria are described below. The pair numbers mentioned refer to those school pairs shown in Table 2 on page 51.

Two exceptions were made to criterion (1). Differences in reading scores and also in language scores between the two members of pair #5 and pair #10 were statistically significant. (With other pairs, differences in these mean scores were not significant.) However, in both instances, the differences were in favor of the school with the lower achievement score in mathematics. To the extent that achievement scores in language and in reading are related to achievement scores in mathematics, one would expect that schools with superior scores in language and reading would do as well or better in mathematics than schools with lower scores in language and in reading. Such was not the case with school pairs #5 and #10. Since these pairings did not

Table 2

Mean Achievement Scores of Selected Tennessee Schools

School Pairs		N*	Mean in Z-Scores			Mean Raw Scores			Statewide Percentile Rank		
			Math.	Lang.	Read.	Math.	Lang.	Read.	Math.	Lang.	Read.
1	A	30	617	383	452	67.5	32.3	35.6	88	12	32
	B	32	393	440	454	47.3	34.6	35.7	14	27	32
2	A	31	687	521	542	74.0	37.9	39.0	97	58	66
	B	23	445	542	540	52.0	38.7	39.0	29	66	65
3	A	30	572	410	444	63.6	33.4	35.3	86	18	29
	B	31	426	444	470	50.3	34.8	36.3	23	29	38
4	A	24	632	542	526	69.0	38.7	38.4	91	66	60
	B	50	440	562	540	51.6	39.5	39.0	27	73	65
5	A	50	529	418	405	59.6	33.7	33.8	61	21	17
	B	62	374	504	515	45.6	37.2	38.3	10	52	56
6	A	48	578	453	494	64.1	35.2	37.3	78	32	48
	B	59	397	444	498	47.6	34.8	37.4	15	29	49
7	A	29	515	391	431	58.3	32.7	34.8	56	14	25
	B	55	341	400	424	42.5	33.0	34.5	6	16	22
8	A	57	536	540	564	59.3	38.6	39.9	64	65	74
	B	56	447	550	530	52.1	39.0	38.6	30	69	62
9	A	32	572	448	509	65.5	34.9	37.8	76	30	54
	B	59	358	489	543	44.1	36.6	39.1	8	46	67
10	A	67	544	448	411	61.0	34.9	34.0	67	30	19
	B	78	379	483	487	46.0	36.4	36.9	11	43	45
11	A	41	585	542	531	64.7	38.7	38.6	80	66	62
	B	24	476	563	581	54.8	39.5	40.5	41	64	79
12	A	41	676	622	602	73.0	41.9	41.3	96	89	85
	B	70	478	601	605	55.0	41.1	41.5	41	84	85
13	A	55	661	593	537	71.6	40.8	38.8	95	82	64
	B	65	476	580	579	54.9	40.2	40.5	41	79	78
14	A	172	582	437	513	64.5	34.5	37.9	79	26	55
	B	107	388	476	517	46.9	36.1	38.1	13	41	57
15	A	37	607	530	549	66.7	38.2	39.3	86	62	69
	B	35	468	521	560	54.1	37.9	39.7	37	58	73
16	A	200	566	490	498	63.0	36.6	37.3	74	46	49
	B	209	444	507	509	51.9	37.3	37.8	29	53	54
No. of Test Items			---	---	---	80	52	48	--	--	--
State Mean			500	500	500	57.0	37.4	37.7	50	50	50

*N represents the number of eighth grade pupils taking test in April, 1979.

Table 3

Schools Which Participated in Research Study

School System	Target School*	Feeder School(s)
Anderson County	Briceville Elementary School	None
Atwood Special District	Atwood High School	Atwood Elementary School
Blount County	Friendsville Elementary School	None
	Porter Elementary School	None
Cannon County	Woodbury Grammar School	None
Carter County	Central Elementary School	None
Cheatham County	Harpeth Junior High	Harpeth Elementary School
Chester County	Chester County Junior High School	East Chester Elementary School Jacks Creek Elementary School North Chester Elementary School West Chester Elementary School
Clay County	Hermitage Springs High School	Hermitage Springs Elementary School
Cocke County	Centerview Elementary School	None
	Edgemont Elementary School	None
	Northwest Elementary School	None
Dyer County	Fifth Consolidated Elementary School	None
Fayette County	Jefferson Elementary School	None
Franklin County	South Junior High School	Broadview Elementary School Cowan Elementary School Keith Springs Elementary School Sewanee Elementary School Sherwood Elementary School
Greene County	DeBusk Elementary School	None
	Ottway Elementary School	None
	West Pines Elementary School	None
Grundy County	Swiss Memorial Elementary School	None
Chattanooga City	Elbert S. Long Junior High School	Elbert S. Long Elementary School
Hardeman County	Hornsby Elementary School	None
Henderson County	Westover Elementary School	None
Maury County	Santa Fe High School	Santa Fe Elementary School
McNairy County	Michie Elementary School	None
Meigs County	Ten Mile Elementary School	None
Polk County	Benton Elementary School	None
Roane County	Midway High School	Midway Elementary School
	Oliver Springs High School	Oliver Springs Elementary School
Scott County	Norma Elementary School	None
Stewart County	W. H. Thomas Elementary School	None
Sumner County	Portland Junior High School	Clyde Riggs Elementary School Watt Hardison Elementary School
Unicoi County	Evans Elementary School	None

*The school that housed the eighth grade class that took the Basis Skills Test in April, 1979.

appear to introduce bias in the research design by providing any advantage in matching to the school with the higher score in mathematics, it was believed that the exception to criterion (1) was in these two cases warranted.

The third exception was made to criterion (3) in the case of school pair #8, for which the difference in mathematics scores was 89 points rather than the 100 points required by the criterion. These two schools, however, were so well matched in all other respects that their inclusion appeared feasible. The difference in their mathematics scores, while slightly less than 100 Z-score points, was nevertheless statistically significant at the 0.02 level of confidence.

The fourth exception was made to criterion (4). For school pair #4, the ratio of the number of eighth grade pupils in the larger school to those in the smaller school was 2.1 instead of 2.0 or less. Again, these two schools satisfied all other criteria so well and the numbers of pupils were not so disparate (50:24) that including these schools as a matched pair seemed to be justified.

Table 2 shows the number of eighth grade pupils taking the Basic Skills Test in each of the selected schools; the mean Z-scores of the schools on the sub-tests of mathematics, language, and reading; the raw mean scores on each of the sub-tests; and the rank of each school on each of the sub-tests when compared with all other public schools within the state. It also shows the number of items on each sub-test and the mean score of all public schools in the state.

Selection of Schools for the Pilot Study

Three pairs of the 16 pairs of schools were selected for the pilot

study. They were selected with the aim of minimizing time and distance of travel. Since the first phase of the research effort was aimed at identifying school-related factors that account for differences in mathematics achievement, it was decided that the three mathematics specialists within the State Department of Education should provide leadership in observing and collecting data for the pilot study. The three specialists were stationed in the cities of Martin, Smyrna, and Cookeville. Three pairs of schools were selected so that two of the six schools were close enough to one of these three cities to minimize distance and time of travel for the mathematics specialists and others from the district offices who would assist them. Except for logistical considerations and random selection, there was no apparent basis for selecting one pair of schools over another for the pilot study. And since statistical sampling was of no concern in connection with the pilot study, there was no reason to choose random selection in preference to logistical considerations. The schools selected for the pilot study were:

Atwood High School, Atwood Special District, Carroll County
Michie Elementary School, McNairy County
Norma Elementary School, Scott County
Santa Fe High School, Maury County
Ten Mile Elementary School, Meigs County
W. T. Thomas Elementary School, Stewart County

Achievement Characteristics of Selected Schools

The process by which schools were selected resulted in a school study population with distinct and desirable achievement characteristics for our research purposes. Table 4 shows the means ($\bar{X}$) and standard deviations (σ) of achievement scores for various sets of schools on the sub-tests of mathematics, language, and reading.

Table 4

Means and Standard Deviations of Mean Achievement Scores of Selected Sets of Schools

School Set	No. of Schools	Score Characteristic	Achievement Test Math.	Lang.	Read.
A	13	$\bar{X}$	65.43	36.87	37.72
		σ	4.59	2.61	2.13
B	13	$\bar{X}$	50.41	37.67	38.74
		σ	3.76	1.89	1.46
A + B	26	$\bar{X}$	57.92	37.26	38.23
		σ	8.60	2.31	1.90
All State Schools	690	$\bar{X}$	57.03	37.40	37.75
		σ	17.02	8.99	8.56
Possible Score			80	52	48

Table 5

Comparisons of Sets of Schools on Three Measures of Achievement

School Sets	No. of Schools	Math t	Math p	Lang. t	Lang. p	Read. t	Read. p
Set A Set B	13 13	9.1	<.001	0.89	n.s.	1.42	n.s
Set A All state schools	13 690	6.6	<.001	0.66	n.s.	0.04	n.s.
Set B All state schools	13 690	5.4	<.001	0.43	n.s.	1.90	n.s.
Both Sets All state schools	13 690	0.49	n.s.	0.25	n.s.	0.97	n.s.

T-tests were used to determine whether the differences between various pairs of means were statistically significant. The resulting t-values and the p (probability)-values are shown in Table 5. The notation "n.s." indicates that the difference in the means of the two sets is "not significant"; the notation "<.001" indicates that the difference in the means is sufficiently large that it could be expected to result by chance in less than one case out of one thousand.

The data in Table 5 are summarized narratively as follows. In mathematics achievement (a) the mean score of schools in Set A was significantly higher than that of schools of Set B; (b) it was also significantly higher than the mean of all public schools in the state; (c) the mean score of schools in Set B was significantly lower than the mean score of all public schools in the state; (d) the mean score of schools in Sets A and B, when combined, did not differ from the mean score of all public schools in the state. In language achievement (a) the mean score of schools in Set A did not differ from that of schools in Set B; (b) the mean of neither set of schools differed from the mean of all public schools in the state. In reading achievement (a) the mean score of schools in Set A did not differ from that of schools in Set B; (b) the mean of neither set of schools differed from the mean of all public schools in the state.

The Variables Investigated

Variables for which data were sought in the main study were identified through three sources: (1) a review of related literature; (2) suggestions from twelve specialists within the State Department of Education, including the department's three mathematics specialists; and (3) information obtained

Table 6

SPECIFIC VARIABLES BY SOURCE OF DATA

Variable Cluster	Reported Teacher Perceptions of:	Reported Pupil Perceptions of:	Field Observers' Reports of:
Leadership	Teacher involvement in curriculum planning Principal's involvement in solving instructional problems Principal's goal emphasis Superintendent's instructional leadership role Effectiveness of in-service programs	X X X	X X X
Curriculum	Scope of local guide Compatibility of textbook & local curriculum guide Vertical coordination Role of textbooks Scope & nature of objectives Program provisions for differential instructional needs	X X X	Integrity of textbook adoption and/or usage
Instruction	Emphasis on drill in basic skills Homework practices Classroom organization Instructional materials	Teachers' questioning techniques Teachers' goal emphasis Differentiation of instruction Homework practices	Scope & nature of objectives Use of aides and/or paraprofessionals
School Policies and Practices	Curriculum coordination Promotion & retention Pupil attendance Scheduled instruction time School organization Class Size	Promotion & retention	Pupil attendance (data from school district attendance officers)
Teacher	Interest in teaching math Difficulty in teaching math Teacher expectations for pupil achievement Certification Academic and professional preparation	Interest in teaching math Nurturance Acceptance	X X X
Pupil	Motivation Preparedness in relation to present grade level	Pre-school experience Motivation Peer attitudes Interest in math	X X X
Parental & Community	Community expectations Parental reinforcement and support	Parental support and reinforcement Parental interest in achievement in math Parental expectations for achievement in math	X X X

from the pilot study, both from field observers and from analyses of data from pupil and teacher questionnaires. More than forty individual variables were grouped into seven variable clusters as shown in Table 6, which also identifies the source of the information collected for each variable. To facilitate later analysis of data, each item on the pupil and teacher questionnaires was keyed to one of the forty or so individual variables.

Procedures Used in Collecting Data

In early March, 1980, the Commissioner of Education sent a letter to each of twenty school superintendents requesting the participation of designated schools within their districts in the department's research program. Full cooperation was forthcoming in all instances.

During the week of March 10-14, meetings were held in Jackson, Knoxville, and Nashville to prepare persons from the district offices in the state's nine development districts for their role in collecting research data. A total of 28 persons attended one of the three orientation meetings. During these meetings the participants were informed about the purposes of the research, the research design, the process and criteria by which schools were selected, and other background information that they might need to answer questions posed by various school personnel. They were provided with the information contained in Tables 2 and 3 (pages 54 and 55) but not in a way such that the achievement scores of any particular school were knowable. To avoid bias and possible discomfort with having to answer questions regarding achievement status at the visitation site, the data collectors were not told whether the particular school they would visit was high-achieving or

low-achieving in mathematics. Neither did they know the identity of the school that was paired with the school they would visit.

In order to standardize data collection procedures, guidelines for making arrangements for the school visits, for meeting with the teaching staff, for administering both teacher and pupil questionnaires, and for obtaining information for the field observer's questionnaire were all discussed in detail. The guidelines were designed to provide as much standardization as feasible yet permit the flexibility needed to accomodate procedures to differing local circumstances. Data collectors were given printed copies of "Guidelines for Field Staff," "Administration of Pupil Questionnaires," and "Field Observer's Questionnaire," all of which are included in the appendix of this document and hence are not discussed in detail here.

Data collectors took from the meetings the requisite number of teacher and pupil questionnaires needed for each school visit. They were asked to make arrangements so that school visits would be completed as early in April as possible. Several scheduling problems occurred, but all school visits were made and all data were collected between March 18 and April 28. Soon after each school visit, all questionnaires completed in that school were returned to the Division of Research and Development, State Department of Education, Nashville, for data processing and interpretation.

CHAPTER V

RESULTS OF THE STUDY

It should be recalled that the school, not the classroom or individual pupil, was the unit of analysis for this investigation. An awareness of this fact is needed in order to avoid inappropriate inferences, especially with regard to reported negative effects. The pilot study revealed considerable variation on certain variables from classroom to classroom within individual schools. And it is possible, even probable, that some of these variables may have a positive effect on pupil achievement in mathematics. Yet when data from all classrooms within a school are pooled to yield data descriptive of the school as a whole, the effect of some critical variables may be obscured. For example, evidence strongly suggests that this "washing out" effect occurred with the math self-concept variable in the pilot study. Although the completed pupil self-concept instruments did not identify individual pupils or classrooms, they were collected in classroom sets. Some classroom sets consisted of generally high math self-concept scores while scores from other classroom sets were considerably lower. But when the results of all classroom sets within a school were combined and compared with those of other schools in which similar variability among classrooms existed, it was found that schools of different achievement status did not differ so far as pupils' math self-concepts are concerned. This does not mean, of course, that the math self-concept, which may be influenced strongly by the teacher of a pupil's most recent exposrue, is not an influential factor in a pupil's achievement.

It means only that a research design that uses the school as the unit of analysis is not sufficiently sensitive to identify any positive effects of that variable. On the other hand, a variable that survives the "washing out" effect sufficiently to distinguish one set of schools from the other set is probably strongly associated with pupil achievement.

The several variables under study in this investigation were classified into seven variable clusters: leadership, curriculum, instruction, school policies and practices, teacher, pupil, and parental/community. The results of the study are presented and discussed under each of these seven headings.

Leadership Variables

Specific leadership variables for which data were collected had to do with: teachers' roles in curriculum planning, the role played by the school principal in helping teachers solve instructional problems, the relative emphasis given by the school principal to various goals of instruction, the role of the school superintendent as an instructional leader, and the effectiveness of in-service programs. Data were collected by means of questionnaires completed by 199 teachers in high-achieving (Set A) schools and 222 teachers in low-achieving (Set B) schools and represent, of course, teachers' perceptions of certain leadership qualities in their schools.

Teachers in the two sets of schools differed in their perceptions of the prevalence of only two of the conditions described by seven questionnaire statements, as shown in Table 7 on the following page. The ratings

by teachers represent the means of their responses to the statements. They were asked to indicate the extent to which each statement represents a condition or practice prevalent in their school, using the following code:

1 - not at all prevalent; or, do not know if it is
2 - prevalent to a very small extent
3 - moderately prevalent
4 - considerably prevalent
5 - strongly or outstandingly prevalent

TABLE 7

TEACHER RATINGS OF LEADERSHIP VARIABLES

Statement	Grades	Mean Rating Set A	Mean Rating Set B	t	d.f.	Significance of Difference
Classroom teachers are (or have been) involved in planning the goals, objectives, content, and scope and sequence of the local mathematics program.	K-8	2.658	3.185	4.15	419	$p < .001$
The principal of my school is willing to help find a source of assistance for teachers to solve whatever problems they encounter in the teaching of mathematics.	K-8	3.694	3.527	1.43	419	n.s.
The principal of my school makes it clear that he/she attaches considerable importance to the achievement of each and every child in math.	K-8	3.685	3.789	0.92	419	n.s.
The principal of my school stresses attention to a broad range of objectives in mathematics that extend well beyond the minimum basic skill objectives defined by the state.	K-8	3.216*	3.126*	0.04	419	n.s.
The principal of my school impresses upon teachers at all grade levels the need to devote the fullest effort that is necessary for pupils to master minimum basic skills in math, as defined by the state, even at the expense of broader objectives.	K-8	3.603*	3.495*	0.90	419	n.s.
The superintendent of schools in my system is a strong instructional leader.	K-8	2.487	2.950	3.48	419	$p < .001$
In-service programs are designed and carried out that provide the amount and kind of help that teachers really need in order to improve the instructional program in mathematics.	K-8	2.261	2.221	0.38	419	n.s.

* Responses to item #13 differ from those to item #12 at the 0.01 level of significance for Set A and for Set B.

Compared with teachers in the high-achieving schools, those in the low-achieving schools reported that they have been more involved in planning the goals, objectives, content, and scope and sequence of the local mathematics program. They also gave significantly higher ratings to the role played by their superintendents as an instructional leader. These findings are ironical because these conditions are frequently associated in the minds of educators with excellent school programs.

Ratings on which teachers in the two sets of schools did not differ are worth noting. Their ratings did not differ with respect to: their principals' willingness to help teachers solve instructional problems in mathematics; their principals' stress on the achievement of each and every child in mathematics; their principals' relative emphasis on a broad or narrow range of objectives; in the value of in-service programs in helping to improve the instructional program in mathematics. In both sets of schools, teachers believe their principals give significantly greater emphasis to pupil achievement on the thirty basic skills objectives than to pupil achievement on a broad range of objectives in mathematics that extend well beyond the minimum objectives defined by the state and measured by the state testing program. Also, teachers in both sets of schools gave low ratings to the value of in-service programs. Across the board, they described in-service programs that provide the amount and kind of help that teachers really need as "prevalent to a very small extent."

Curriculum Variables

The teacher questionnaire asked teachers to rate nineteen statements having to do with the following: the scope of the local curriculum guide; the compatibility of the adopted math textbook with the local curriculum guide; the extent of coordination in the math program from grade level to grade level; the role of the textbook versus teacher planning as a determinant of content and instructional sequence; the scope and nature of instructional objectives; and provisions for differential instructional needs of pupils. During school visits, field staff members collected information on the particular mathematics textbooks used by members of the eighth grade class of 1979-80 since their entry into school.

School Differences

Responses of teachers in the two sets of schools differed on only four of the nineteen statements relating to curriculum variables. (See Table 8 on pages 68-69.) Again, the differences appear contrary to conventional wisdom. Compared with teachers in high-achieving schools (Set A), teachers in low-achieving schools (Set B) reported:

(1) a greater prevalence of locally developed curriculum guides that include but surpass in scope the objectives for math instruction outlined in Tennessee's Student Expectations in the Basic Skills, K-6 (30 objectives). As was noted on page 66, these teachers reported that they have been more personally involved with the development of their curriculum guides than have teachers in high-achieving schools.

(2) the basal mathematics textbooks used in the low-achieving schools are more highly compatible with the local curriculum guide.

TABLE 8

TEACHER RATINGS OF CURRICULUM VARIABLES

	Statement	Grades	Mean Rating Set A	Mean Rating Set B	t	d.f.	Significance of Difference
§	My school system uses a locally developed curriculum guide that includes but surpasses in scope the objectives for math instruction outlined in Tennessee's Student Expectations in the Basic Skills, K-6.	K-8	2.472	2.743	2.17	419	$p < .05$
§	The basal mathematics textbooks used in my school are highly compatible with the local curriculum guide. (Check #1 if there is no local curriculum guide.)	K-8	2.558	2.856	2.23	419	$p < .05$
§	Textbooks and other teaching materials in primary use in our math program provide for continuity and a well-integrated instructional program from grade level to grade level.	K-8	3.432	3.496	0.59	419	n.s.
§	In the local school(s), we are successful in avoiding gaps and unnecessary repetition in the mathematics program.	K-8	2.477	2.536	0.57	419	n.s.
§	My instructional program in mathematics adheres strictly to the content and instructional sequence of the adopted textbook.	K-8	2.889*	3.072*	1.73	419	n.s.
§	Based on my assessment of pupil achievement and the local objectives for math instruction, I am permitted to, and do, select the content and plan the instructional sequence of the year's program, then use the textbook and supplementary materials in ways that best fit those plans.	K-8	3.809*	3.820*	0.10	419	n.s.
§	The curriculum guide developed for use in my school (system) identifies objectives that specify what should be taught and what each child should master at each grade or achievement level up through grade 8.	K-8	3.000	3.374	2.75	419	$p < .01$
Ω	Our math program stresses conceptual learnings in math at the expense of computational skills.	1-3	2.487	2.398	0.61	174	n.s.
		4-6	2.118	2.291	1.06	104	n.s.
		7-8	2.410	2.632	1.14	75	n.s.
		K-8	2.387	2.455	0.76	419	n.s.
Ω	Our math program stresses computational skills at the expense of conceptual learnings.	1-3	2.615	2.622	0.05	175	n.s.
		4-6	2.608	2.800	0.98	104	n.s.
		7-8	2.820	2.632	0.92	75	n.s.
		K-8	2.633	2.680	0.51	419	n.s.
Ω	Our math program strikes a desirable balance between stressing conceptual learnings and computational skills.	1-3	3.436	3.500	0.46	175	n.s.
		4-6	3.451	3.473	0.11	104	n.s.
		7-8	3.641	3.447	1.00	75	n.s.
		K-8	3.482	3.468	0.15	419	n.s.
Ω	Our math program stresses "modern math" over "traditional math."	1-3	2.333	2.408	0.52	174	n.s.
		4-6	1.843	2.091	1.51	104	n.s.
		7-8	2.000	2.316	1.50	75	n.s.
		K-8	2.186**	2.333**	1.61	419	n.s.
Ω	Our math program stresses "traditional math" over "modern math."	1-3	3.154	3.122	0.19	174	n.s.
		4-6	3.372	3.364	0.04	104	n.s.
		7-8	3.667	3.237	1.77	75	n.s.
		K-8	3.264**	3.185**	0.85	419	n.s.
Ω	Our math program strikes a desirable balance between "modern math" and "traditional math."	1-3	3.026	3.265	1.48	174	n.s.
		4-6	2.941	3.164	0.99	104	n.s.
		7-8	2.974	3.342	1.52	75	n.s.
		K-8	3.080	3.261	1.75	419	n.s.

TABLE 8 (Con't.)

TEACHER RATINGS OF CURRICULUM VARIABLES

	Statement	Grades	Mean Rating Set A	Mean Rating Set B	t	d.f.	Significance of Difference
§	My school has a well-planned and successful accelerated or enrichment math program for fast-learning, highly able pupils.	K-8	1.925	1.870	0.50	419	n.s.
§	My school's math program challenges fast-learning pupils.	1-3	2.769	2.510	1.56	174	n.s.
		4-6	3.039	2.764	1.18	104	n.s.
		7-8	3.128	2.868	0.88	75	n.s.
		K-8	2.955	2.604	3.02	419	$p < .01$
§	My school's math program adequately provides for the learning needs of slow-learning or low-achieving pupils.	1-3	3.205	3.000	1.22	174	n.s.
		4-6	3.392	3.382	0.04	104	n.s.
		7-8	3.590	3.421	0.67	75	n.s.
		K-8	3.362	3.176	1.67	419	n.s.
§	My school has an effective program for the systematic diagnosis of pupil learning difficulties.	1-3	2.897	2.724	0.95	174	n.s.
		4-6	3.000	3.109	0.84	104	n.s.
		7-8	3.103	2.842	0.94	75	n.s.
		K-8	2.960	2.856	0.88	419	n.s.
§	My school provides adequately for remedial instruction beyond what can be accomplished by the regular classroom teacher.	1-3	3.090	3.041	0.25	174	n.s.
		4-6	3.176	3.236	0.24	104	n.s.
		7-8	3.359	3.210	0.52	75	n.s.
		K-8	3.292	3.167	1.00	419	n.s.
Ω	My school has a successful remedial program in mathematics.	K-8	3.352	3.054	2.48	419	n.s.

* Teachers in both sets of schools rated item 19 significantly higher (at the 0.001 level of significance) than they rated item 18.

** Teachers in both sets of schools rated item 40 significantly higher (at the 0.001 level of significance) than they rated item 39.

§ Rating scale for the these items:

1 - not at all prevalent; or, do not know if it is
2 - prevalent to a very small extent
3 - moderately prevalent
4 - considerably prevalent
5- strongly or outstandingly prevalent

Ω Rating scale for these items:

1 - Strongly Disagree
2 - Disagree
3 - Uncertain
4 - Agree
5 - Strongly Agree

(3) a greater prevalence of curriculum guides that specify what should be taught and what each child should master at each grade or achievement level up through grade eight.

(4) a lesser prevalence of math programs that challenge fast-learning pupils.

School Similarities and Notable Characteristics

Teachers in the two sets of schools did not differ in their reports of the prevalence of provisions for continuity within the math program or for avoiding gaps and unnecessary repetition of instruction. In truth, teachers in all schools reported such arrangements to be "moderately prevalent," not considerably or strongly prevalent.

The two sets of teachers did not differ on whether the content and sequence of the mathematics instructional program are determined more by the adopted textbooks or by local professional planning. All of them reported a significantly greater prevalence of local professional planning than adherence to the content and sequence of textbooks.

Teachers in both sets of schools generally agreed that their schools' math programs strike a desirable balance between stressing conceptual learnings and computational skills. Their concept of "balance," however, apparently is tilted in favor of computational skills over conceptual learnings. The entire sample of teachers gave significantly higher ratings ($p < .05$) to the stress on computational skills than to conceptual learnings. The responses of teachers of grades seven and eight were especially interesting. Those in the low-achieving schools reported equal

stress to the two types of learning. On the other hand, seventh and eighth grade teachers in the high-achieving schools reported significantly greater emphasis ($p = .05$) on computational skills (2.82) than on conceptual learnings (2.41). It may well be that this finding accounts in part for the superior Basic Skills Test scores of these teachers' pupils. One must ponder the cost in inadequately developed conceptual learnings that will be needed by many of these pupils in secondary school mathematics.

Teachers in both sets of schools agreed that their math programs strike a desirable balance between "modern" and "traditional" math. What was considered a desirable balance is one that stresses "traditional" over "modern" math. Although the emphases reported by teachers in the two sets of schools did not differ statistically, teachers in low-achieving schools tended to describe their math programs as giving more stress to "modern" math; whereas those in high-achieving schools tended to describe their programs as stressing "traditional" math more than "modern" math. This tendency was strongest among teachers of grades seven and eight and is consistent with reports by these same teachers that they stress computational skills to a greater extent than they stress conceptual learnings.

The ratings assigned the following two statements are interesting (see top two items, Table 8 (con't.), page 69).

(a) My school has a *well-planned* and successful *accelerated* or *enrichment* math program for fast-learning or highly able pupils. (Italics added.)

(b) My school's mathematics program *challenges* fast learning pupils. (Italics added.)

Both sets of teachers rated statement (b) significantly higher ($p < .001$) than statement (a). One interpretation of the difference in responses is

that teachers made distinctions in the two statements on the basis of the italicized words. If so, they appear to be saying that their schools are weak in identifiable programs characterized by acceleration or enrichment, but they as teachers are not doing such a bad job in challenging these pupils on an individual basis. As reported earlier, teachers in the high-achieving schools believe they are more successful in challenging fast-learning pupils than do teachers in low-achieving schools.

Teachers in the two sets of schools did not differ in their opinions of the adequacy of provisions for the learning needs of slow-learning or low-achieving pupils, of their school's effectiveness in the systematic diagnosis of pupil learning difficulties, or the success of their school's remedial programs in mathematics. On all of these, teachers generally agreed that these features are "moderately" prevalent. It is instructive to note that these teachers believe schools are providing more adequately for the needs of slow-learning or low-achieving pupils than they are for fast-learning or highly able pupils. An inspection of teacher ratings leads one to infer that teachers have a far greater institutional support system in meeting the needs of pupils with learning deficiencies than in meeting the needs of exceptionally capable pupils.

Anecdotal Data

Field observers, who administered questionnaires in the selected schools, also collected information on textbook usage from school records. The information consisted of the identity of basal textbooks or materials that were used in teaching math to the eighth grade class of 1979-80 since that group of pupils entered first grade. No discernible pattern of text-book usage clearly characterized the two sets of schools. Although a small

number of schools in each set of schools have used textbooks of a single publisher for all eight grades of instruction, the use of textbooks from two or three different publishers has been common. All schools collectively reported having used textbooks of more than a dozen publishers, but those of five publishers were used predominantly and to a nearly equivalent extent in both high-achieving and low-achieving schools. A check was made to determine whether the two sets of schools differed in their use of materials from one, two, or three different publishers. The dominant pattern was for high-achieving schools to use textbooks by two different publishers and for low-achieving schools to use textbooks from three different publishers throughout the eight grades, but the pattern difference was not statistically significant. These data do not warrant an inference that the achievement difference in the two sets of schools is influenced by the particular textbooks in use or by the number of publishers whose textbooks are used throughout the elementary school grades.

Field observers interviewed teachers of eighth grade math in an effort to determine what, if any, efforts had been made during the school year to prepare pupils specifically for the Basic Skills Test. Teachers in 11 of the 13 high-achieving schools reported giving intensive emphasis to the 30 minimum objectives in mathematics, whereas teachers in only five of the low-achieving schools reported doing so. The reports below were typical of eighth grade teachers in high-achieving schools:

--the class reviewed the old (1978) test and stressed K-6 objectives.

--teacher teaches a unit on each of the 30 objectives in the 8th grade.

-- Orbit (1978) test was given prior to this year's test; results were used to prepare pupils for the recent test.

--8th grade teacher boasted of strong emphasis on basic skills without modern math. Teacher attributed high test scores to this emphasis.

The comments below were reported from several, although not all, of the low-achieving schools:

--the principal, who teaches math, stresses a broad range of objectives, not minimal skills, at the 8th grade level.

--no strong emphasis is given to minimum basic skills beyond the 6th grade.

--we did not emphasize minimum skills in the 8th grade in 1978-79, but we learned if we wanted to come up with test scores that would impress the community we would have to do so in the future. And we have this year.

--in the eighth grade we emphasize concepts of algebra to prepare pupils for high school algebra.

Anecdotal accounts, such as those reported above, lead one to suspect that high-achieving schools place greater emphasis on instruction geared specifically to the objectives to be tested by the state than do the low-achieving schools. A few field observers said their impression was that in certain high-achieving schools virtually the entire eighth grade math program was geared to producing high scores on the Basis Skills Test. One field observer asked one of these eighth grade teachers what provisions he made for better-than-average or fast-learning pupils who are already proficient in the minimum basic skills. His response, in substance, was--our better students have had exceptionally high scores on the Basic Skills Test; we seem to be doing a good job with them too. There appeared to be little recognition that some of these pupils were not being challenged beyond the ceiling (and a rather low ceiling for these pupils) of a test on minimum basic skills--a total of 30 objectives for their entire eight years of mathematics. The anecdotal accounts reported here are consistent

with teacher responses to a particular questionnaire item, the results of which are reported in Table 9 in the next section.

Instructional Variables

The teacher questionnaire included sixteen items designed to obtain teacher ratings on the following: emphasis on drill in basic skills; homework expectations and practices; classroom organization; and availability and suitability of instructional materials. The pupil questionnaire, administered only in grades five through eight, contained 21 items pertaining to: teachers' questioning techniques, teachers' goal emphasis, differentiation of instruction, and homework practices.

School Differences

Drill in Basis Skills. Differences were revealing in teachers' responses to the item, "My school's math program stresses the practice and repetition needed for pupils to master the minimum basic skills, as defined by the state" (see first statement, Table 9, next page). When the ratings of all teachers, K-8 were combined, those of teachers in high-achieving schools were slightly higher than those of teachers in low-achieving schools, but the difference in mean ratings was not sufficiently large to be statistically significant. However, the ratings of teachers of grades seven and eight in the high-achieving schools were significantly higher than those of their counterparts in the low-achieving schools. Moreover, ratings of teachers of grades seven and eight in the high-achieving schools were significantly higher than those of teachers of grades four through six in the same high-achieving schools. By contrast, ratings by

TABLE 9

TEACHER RATINGS OF INSTRUCTIONAL VARIABLES

Statement	Grades	Mean Rating Set A	Mean Rating Set B	t	d.f.	Significance of Difference
My school's math program stresses the practice and repetition needed for pupils to master the minimum basic skills, as defined by the state.	1-3	3.641	3.510	0.83	174	n.s.
	4-6	3.745	4.036[b]	1.37	104	n.s.
	7-8	4.154[a]	3.526	2.79	75	p < .01
	K-8	3.834	3.658	1.73	419	n.s.
Math homework assignments are checked thoroughly by the teacher (or aide) for accuracy of solutions.	1-3	3.705	4.020	1.38	174	n.s.
	4-6	4.078	4.454	2.31	104	p < .05
	7-8	3.923	4.342	2.11	75	p < .05
	K-8	3.858	3.892	1.63	419	n.s.
Math homework assignments are checked quickly by the teacher (or aide) for completeness rather than for accuracy of solutions.	1-3	2.449	2.296	0.91	174	n.s.
	4-6	2.863	2.800	0.28	104	n.s.
	7-8	2.795	3.053	1.01	75	n.s.
	K-8	2.487	2.432	0.49	419	n.s.
Pupils in my class exchange papers and correct each others' math homework as we go over the assignment in class.	1-3	2.013	2.174	1.11	174	n.s.
	4-6	2.922	3.054	0.70	104	n.s.
	7-8	3.026	3.158	0.60	75	n.s.
	K-8	2.372	2.464	0.85	419	n.s.
Pupils in my class correct their own math homework as we go over the assignment in class.	1-3	2.667	2.622	0.23	174	n.s.
	4-6	3.333	3.436	0.56	104	n.s.
	7-8	3.436	3.158	1.24	75	n.s.
	K-8	2.849	2.743	0.87	419	n.s.
Supplementary materials for teaching math (such as games, puzzles, worksheets, and other non-textbook devices) are available in adequate quantities.	K-8	2.477	2.468	0.07	419	n.s.
Supplementary materials for teaching mathematics are available in a variety that is appropriate for the range of achievement levels of pupils in my classroom.	K-8	2.528	2.504	0.20	419	n.s.
I place primary emphasis on the minimum basic skills in mathematics, as defined by the state, and place secondary emphasis on other objectives of matheratics instruction.	1-3	3.641[c]	3.786	1.07	174	n.s.
	4-6	3.843	4.071[d]	1.26	104	n.s.
	7-8	4.026[c]	3.447[d]	2.41	75	p < .05
	K-8	3.814	3.770	0.46	419	n.s.
I emphasize a broad range of objectives that are important in the growth and development of children, of which the minimum basic skills are a small, although important, part.	1-3	3.385	3.163	1.30	174	n.s.
	4-6	3.020	3.073	0.24	104	n.s.
	7-8	3.026[e]	3.053[f]	0.10	75	n.s.
	K-8	3.181	3.189	0.08	419	n.s.
The same homework assignment in math is given to the entire class.	1-3	3.154	3.036	0.65	174	n.s.
	4-6	3.647	3.800	0.63	104	n.s.
	7-8	3.846	3.921	0.28	75	n.s.
	K-8	3.231	3.320	0.60	419	n.s.
Different individuals and/or small groups are given different assignments in math based on different achievement levels.	1-3	3.449	3.367	0.50	174	n.s.
	4-6	3.510	3.836	1.59	104	n.s.
	7-8	3.308	3.263	0.16	75	n.s.
	K-8	3.452	3.460	0.06	419	n.s.
The same instructional materials are used by all pupils, even if they do not all use the same materials at the same time.	1-3	3.744	4.163	2.30	174	p < .05
	4-6	4.039	3.927	0.50	104	n.s.
	7-8	3.795	3.737	0.24	75	n.s.
	K-8	3.884	4.004	1.09	419	n.s.
I organize and plan mathematics instruction for my class as a whole rather than for different small groups or individuals within the class. (Teachers with split grades, consider one grade level as a whole class.)	1-3	3.731	3.847	0.68	174	n.s.
	4-6	3.667	3.636	0.12	104	n.s.
	7-8	3.513	3.632	0.44	75	n.s.
	K-8	3.593	3.694	0.86	419	n.s.
I plan mathematics instruction for small groups or individuals, organized on the basis of achievement levels, rather than for the class as a whole. (Teachers with split grades, consider a grade level as a whole class.)	1-3	3.038	3.133	0.58	174	n.s.
	4-6	3.353	3.327	0.11	104	n.s.
	7-8	3.180	3.000	0.63	75	n.s.
	K-8	3.211	3.243	0.29	419	n.s.

[a] In Set A ratings by teachers of grades 7-8 were significantly higher ($p<.05$) than ratings by teachers of grades 4-6.
[b] In Set B ratings by teachers of grades 4-6 were significantly higher ($p<.05$) than ratings by teachers of grades 7-8.
[c] In Set A ratings by teachers of grades 1-3 differ from those of teachers of grades 7-8, $p<.05$.
[d] In Set B, ratings by teachers of grades 7-8 differ from those of teachers of grades 4-6, $p<.01$.
[e] In Set A, teachers of grades 7-8 differed in their responses to items #20 and #21 ($t = 4.15$, $df = 76$, $p<.001$).
[f] In Set B, teachers of grades 7-8 did not differ in their responses to items #20 and #21 ($t = 1.52$, $df = 74$).

teachers of grades four through six in the low-achieving schools were significantly higher than those of teachers of grades seven and eight in the same low-achieving schools. It seems clear that the greatest emphasis has been given to the practice and repetition needed for mastery of minimum basic skills in grades seven and eight in high-achieving schools and in grades four through six in the low-achieving schools.

Goal Emphasis. The results discussed above are consistent with the ratings on emphases on narrow versus broad objectives expressed by teachers of various grade levels in the two sets of schools. Seventh and eighth grade teachers in high-achieving schools claim to place significantly greater emphasis on the minimum baskc skills than do their counterparts in the low-achieving schools or than do their colleagues who teach in the lower grades in the high-achieving schools. In fact, seventh and eighth grade teachers in high-achieving schools give significantly greater emphasis to the development of minimum basic skills than to a broad range of objectives, whereas their counterparts in the low-achieving schools stress a broad range of objectives about as much as they stress minimum basic skills. Again, primary emphasis on the mastery of basic skills appears to have occurred in grades seven and eight in high-achieving schools and in grades four through six in the low-achieving schools; and it is least in grades one through three in high-achieving schools and in grades seven and eight in low-achieving schools. Perhaps a reminder is in order that the minimum basic skills measured by the Basic Skills Test are for the most part ones the mastery of which is expected by the end of the sixth grade.

These findings offer the temptation to qualify the designation of "high and low-achieving schools" by adding the phrase "in the minimum basic skills." It is an open question as to whether the classifications of high-achieving and low-achieving schools would hold up if pupil achievement in mathematics were measured in terms of a broad range of objectives. At any rate, one must question the extent to which the mathematics program in the upper elementary grades of some schools is being distorted by the assessment and public reporting of basic skill mastery at the end of the eighth grade. One must ponder the effect of this emphasis on pupils, especially those whose achievement in mathematics is better than average. One wonders if the designation "low-achieving school" may be the price that some schools pay for emphasizing minimum basic skills in the middle grades while preserving in the upper elementary grades the integrity of a balanced curriculum that stresses a broad range of objectives with increasing levels of abstraction in preparation for secondary school mathematics. And finally, one must consider the eventual effect of this emphasis on secondary school mathematics programs.

Pupils in the two sets of schools differed in their responses to two of the five items having to do with goals or objectives of mathematics instruction. Pupils perceived that teachers in high-achieving schools more often ask questions about things pupils have memorized and that they more often encourage pupils to consider the reasonableness of mathematical solutions than do teachers in low-achieving schools.

Homework Practices. Teachers in the two sets of schools differed in their responses to two of six items dealing with homework practices. Those in low-achieving schools, grades four through eight, reported that they

(or an aide) more often check pupils' math homework thoroughly for accuracy of solutions than do teachers in high-achieving schools. These reports by teachers were borne out by pupil responses (Table 11). Although pupils in high-achieving schools, compared with those in low-achieving schools, reported their teachers more often check their homework assignments just for completeness and more often ask pupils to correct their own homework, pupil perceptions were not in these instances consistent with teachers' reports (Table 9). According to pupils, teachers in high-achieving schools assign homework more often than is the case in low-achieving schools.

Primary grade (1-3) teachers in high-achieving schools, but not those in middle and upper grades, say they allow more time than do those in low-achieving schools for pupils to work on math homework during math class (see Table 10).

TABLE 10

TEACHER EXPECTATIONS FOR TIME SPENT ON MATH HOMEWORK

Statement	Grades	Mean Time (min.) Set A	Set B	t	d.f.	Significance of Difference
How many minutes are available to a pupil for working on math homework during math class on a typical day?	1-3	15.7	11.8	2.04	172	$p < .05$
	4-6	19.7	18.9	0.41	104	n.s.
	7-8	19.5	19.9	0.15	75	n.s.
How many minutes a day do you expect a typical pupil to spend doing math homework outside of math class for a typical assignment?	1-3	11.3	10.3	0.57	173	n.s.
	4-6	19.5	19.2	0.13	104	n.s.
	7-8	20.7	23.3	1.16	75	n.s.

However, pupils in low-achieving schools, grades five through eight, claim that their teachers allow more time in math class for working on math homework than was claimed by pupils in high-achieving schools.

TABLE 11

PUPIL RATINGS OF INSTRUCTIONAL VARIABLES

Statement	Grade(s)	Mean Rating Set A	Mean Rating Set B	t	d.f.	Significance of Difference
My teacher usually checks my math homework and marks the problems that I get right or wrong.	5-8	3.391	3.614	5.30	5768	$p < .001$
My teacher usually checks my homework just to see if I have completed the assignment.	5-8	3.462	3.257	4.89	5775	$p < .001$
My teacher gives a math homework assigrment almost every day.	5-8	4.041	3.576	11.81	5775	$p < .001$
If I didn't do a math homework assignment, my teacher would surely know it.	5-8	4.202	4.123	2.40	5764	$p < .02$
My teacher often assigns extra math problems to pupils who misbehave.	5-8	2.704	2.751	1.11	5757	n.s.
My teacher lets us do most of our math homework during math class.	5-8	3.910	4.203	8.08	5757	$p < .001$
My teacher often lets pupils in my class exchange papers and correct each others' math homework as we go over the assignment in class.	5-8	2.900	2.933	0.74	5747	n.s.
My teacher often lets us correct our own homework as we go over the assignment in class.	5-8	3.505	3.362	3.37	5751	$p < .001$
If I do not know the answer to a math question right away, my teacher gives me time and helps me think before asking somebody else to answer the question.	5-8	4.017	3.935	2.36	5783	$p < .02$
If I do not know how to answer a math question right away, my teacher asks somebody else to answer before I've had enough time to think of an answer.	5-8	2.221	2.232	0.28	5778	n.s.
My math teacher asks questions about things I have learned by heart (memorized).	5-8	3.583	3.446	3.71	5766	$p < .001$
My teacher asks questions in math that make me do a lot of thinking about how to solve problems.	5-8	3.953	3.938	0.45	5752	n.s.
My teacher is just as interested in how I solve math problems as in my getting the right answer.	5-8	4.121	4.098	0.68	5759	n.s.
My math teacher tries to help me understand how math is needed and used in everyday life.	5-8	4.137	4.176	1.21	5757	n.s.
My teacher often tells us to think about whether the answer to a math problem is reasonable.	5-8	3.768	3.694	2.20	5767	$p < .05$
My teacher usually teaches different things in math class to different pupils.	5-8	2.527	2.221	7.18	5768	$p < .001$
My teacher usually teaches the same thing to everyone in the class during a math class.	5-8	4.011	4.238	5.98	5773	$p < .001$
My teacher usually gives the same homework assignment in math to everyone in the class.	5-8	4.039	4.188	3.85	5770	$p < .001$
My teacher often given different homework assignment in math to different pupils.	5-8	2.242	1.986	6.28	5756	$p < .001$
My math class goes over new things so fast that I often have trouble keeping up and understanding what I should learn.	5-8	2.548	2.644	2.32	5758	$p < .05$
I could learn much more math if my class studied more new things and did not spend so much time drilling on things that I already know.	5	3.221	3.011	2.53	1459	$p < .02$
	6	3.283	3.059	2.75	1408	$p < .01$
	7	3.039	3.023	0.20	1439	n.s.
	8	2.950	3.028	0.98	1430	n.s.
	5-8	3.122	3.030	2.27	5761	$p < .05$

Differentiated Instruction. Teachers from the two sets of schools did not differ in their responses to any of the five questionnaire items having to do with provisions for differential learning needs of pupils. Neither set of teachers reported a greater prevalence of intraclass grouping based on ability or achievement, versus whole class instruction, or different homework assignments for individuals or small groups, versus the same assignment for all pupils, or the use of different, versus the same, instructional materials within the class. Pupils, on the other hand, differed in their perceptions of several of these practices. While all pupils reported a greater prevalence of uniform instruction and homework assignments than of differentiated instruction and homework assignments, pupils in low-achieving schools reported a greater prevalence of uniform instruction and homework assignments (grades 5-8) in their schools whereas those in high-achieving schools reported a greater incidence of differentiated instruction and homework assignments. These differences in expressed pupil perceptions were all statistically significant at the 0.001 level.

Pace of Instruction. To an extent that was statistically significant, pupils in the two sets of schools differed in their perceptions of the pace of instruction. Compared with each other, pupils in low-achieving schools reported a greater incidence of going over new things (concepts, skills) so fast that many pupils have trouble keeping up and understanding what they should learn, whereas pupils in high-achieving schools felt more strongly that they could learn more math if their class studied more new things and did not spend so much time drilling on things pupils already know. These differences in pupil reactions may represent nothing more than differences in the abilities or achievement levels of the populations of the two sets

of schools. On the other hand, they may reflect pupil responses to the greater emphasis on basic skills, and to the concomitant practice and repetition, in the upper grades of high-achieving schools and to the bac relatively greater stress on a broad range of objectives, with the development of new skills and concepts, in the upper grades of low-achieving schools. Available data shed no light on either hypothesis.

School Similarities and Notable Characteristics

No differences were reported between the two sets of schools with respect to: (a) teacher claims of checking homework assignments for completeness rather than accuracy; (b) pupils correcting each others' homework; (c) the amount of time teachers expect pupils to spend on math homework outside of math class (Table 10); (d) pupil perceptions of teacher knowledge of pupil failure to do homework; (e) teacher reports of the availability of supplementary instructional materials in an adequate quantity and appropriate variety; (f) the assignment of extra math problems as punishment for misbehavior; (g) pupil perception of "wait time" practiced by teachers following the asking of a question; (h) pupil perceptions of the extent to which their teachers ask questions that make pupils think about how to solve problems; (i) pupil perceptions of the extent to which their teachers are as interested in the process as in the product of problem solving; and (j) the extent to which teachers ask pupils to think about the reasonableness of solutions.

Although certain features do not distinguish high from low-achieving schools, it may be worthwhile to identify them if only to note the status of these features in all the sample schools. In both sets of schools the

practice of teachers examining homework for accuracy is considerably more prevalent than the practice of checking homework quickly only for completeness, of having pupils correct their own homework, or of having pupils check each other's homework.

Although teachers in the two sets of schools did not report differences in the availability or suitability of supplementary teaching materials, all of them rated the quantity and variety of such materials as between "prevalent to a very small extent" and "moderately prevalent." One is led to conclude that teachers generally feel they need supplementary instructional materials both in greater quantity and in a greater variety appropriate for the range of achievement levels in their classes.

Although teachers in the two sets of schools differ in the relative emphasis they place on the development of basic skills at different grade levels, teachers in both sets of schools reported a significantly greater attention to basic skills than to a broader range of objectives for math instruction. On a scale from one to five, the mean rating for stress on basic skills was near four (considerably prevalent) while the mean rating for broader objectives was about three (moderately prevalent).

Intraclass grouping based on differences in achievement has been less prevalent in all grade levels in both sets of schools than instruction planned and carried out for the class as a whole. While pupils in the two sets of schools differed in their perceptions of the prevalence of differentiated homework assignments, pupils in both sets of schools nevertheless reported that the assignment of the same homework to an entire class is by far more prevalent than the assignment of different homework to different individuals or small groups.

As reported previously, pupils in the two sets of schools differed in their perceptions of the pace of instruction as being too slow or too fast, it was also true that more pupils in all schools felt the pace was too slow than who felt it to be too fast. It may be that this message is coming from the sub-population of better-than-average pupils in all schools who are not benefitting from the greater stress in all schools, especially in the seventh and eighth grades, to basic skills than to a broad domain of objectives that would be more appropriate to the learning needs and motivation of such pupils.

Pupils in the two sets of schools gave different ratings to statements relating to teachers' "wait time" following the asking of a question. Nevertheless, those who gave strong ratings to their teachers for giving them time and helping them think through an answer before directing the question to someone else far outweighed those pupils who reported their teachers ask somebody else to answer before they have had enough time to think of an answer.

School Policies and Practices

Specific factors that were investigated as part of the variable cluster of school policies and practices were: curriculum coordination, pupil attendance, scheduled instruction time, type of school organization, class size, and pupil retention and promotion practices. Since no differences were found between the two sets of school, with the exception of differences in the grade levels at which retentions occur, the findings are reported for each of these variables in order.

Curriculum Coordination

The first item in Table 12 shows that teachers in the two sets of schools did not differ in their perceptions of the extent to which there are firm arrangements and regular discussions between teachers at different grade levels (and between schools, if appropriate) to avoid gaps and unnecessary repetition in the mathematics program.

TABLE 12

TEACHER RATINGS OF SCHOOL POLICIES AND PRACTICES

Statement	Grades	Mean Rating Set A	Mean Rating Set B	t	d.f.	Significance of Difference
In my school, there are firm arrangements and regular discussions between teachers at different grade levels (and between schools, if appropriate) to avoid gaps and unnecessary repetition in the mathematics program.	K-8	2.306	2.315	0.08	419	n.s.
Pupils who are not in a special education program are not generally promoted from one grade to another unless their achievement in mathematics is at, or very near, grade level.	1-3	2.526	2.571	0.27	174	n.s.
	4-6	2.314	2.582	1.21	104	n.s.
	7-8	2.256	2.290	0.13	75	n.s.
	K-8	2.337	2.460	1.11	419	n.s.
My school makes a concerted effort to discourage unnecessary absence of pupils and communicates that position to parents.	K-8	4.000	3.996	0.04	419	n.s.

While the means of teachers' ratings were virtually identical, it should be noted that both means are only 2.3 on a scale from one to five, which translates to only slightly better than "prevalent to a very small extent." Clearly, much remains to be done to improve coordination in all schools and districts represented in this study, probably in all schools and districts within the state.

Pupil Attendance

Teachers in the two sets of schools did not differ in their opinions as to the extent to which their schools make a concerted effort to discourage unnecessary pupil absence and to which schools communicate that position to parents (see Table 12). Teachers in all schools rated this condition as "considerably prevalent."

In a separate effort, school attendance data for the 1978-79 school year were collected from the school district attendance officers by the attendance specialist in the State Department of Education. These attendance data are displayed in Table 13 on the following page. As the data in Table 13 show, the two sets of schools did not differ in their ratios of average daily attendance to average daily membership. The ratios for low-achieving and high-achieving schools, respectively, were 0.94 and 0.95.

Scheduled Instruction Time

On the teacher questionnaire, teachers were asked to indicate how many minutes, on the average, pupils in their classes receive instruction in mathematics, including any time spent in class working on a homework assignment. The average amount of time allocated for math at various grade levels in the two sets of schools is shown in Table 14 on the following page. Although there are slight differences in these average times, none of the differences is statistically significant.

Teachers were also asked how many minutes are available on a typical day for pupils to work on math homework during math class (see Table 10, page 79). The mean times ranged from 12 to 16 minutes in grades one

TABLE 13

ATTENDANCE DATA FOR 1978-79

FOR HIGH AND LOW-ACHIEVING SCHOOLS IN MATHEMATICS

Low-achieving Schools				High-achieving Schools			
School	ADM[1]	ADA[2]	%	School	ADM[1]	ADA[2]	%
1	170.0	161.5	95.0	1	336.2	323.4	96.2
2	359.2	350.3	97.5	2	249.0	235.0	94.4
3	616.0	561.0	91.1	3	346.5	324.9	93.8
4	456.0	432.0	94.7	4	458.7	428.2	93.4
5	532.0	484.7	91.1	5	486.3	464.9	95.6
6	569.0	533.5	93.8	6	288.6	280.7	97.3
7	764.0	706.0	92.4	7	442.9	441.3	99.7
8	360.3	335.8	93.2	8	315.0	299.0	94.0
9	705.0	648.5	92.0	9	319.0	309.0	96.9
10	622.0	587.0	94.4	10	392.0	367.0	93.6
11	814.0	772.0	94.8	11	1473.8	1368.8	92.9
12	388.0	357.0	92.0	12	312.0	287.0	92.0
13	1638.7	1552.3	94.8	13	1129.7	1066.3	94.4
		Mean[3]	93.6			Mean[3]	94.9
	Standard Deviation		1.86		Standard Deviation		2.12

[1]Average Daily Membership
[2]Average Daily Attendance
[3]The t-value for the difference between the means was 1.67. A t-value of 2.06, with 24 degrees of freedom, is required to reject the null hypothesis at the 0.05 level of significance.

TABLE 14

TIME ALLOCATED FOR MATH INSTRUCTION

Statement	Grades	Mean Time (min.) Set A	Set B	t	d.f.	Significance of Difference
On the average, how many minutes on a typical day does a pupil in your class receive instruction in mathematics, including any time spent in class working on a homework assignment?	1-3	41.1	44.1	1.63	172	n.s.
	4-6	48.1	46.6	0.86	104	n.s.
	7-8	46.3	44.2	0.93	75	n.s.

through three and 19 to 20 minutes for grades four and above. In many instances teachers may take advantage of time allocated for doing homework in class to provide instruction to individuals or small groups in need of special attention. In other instances, teachers may not use this time to the best advantage of pupils. By taking differences in the times reported in Table 14 and those shown in Table 10, one finds that the time of instruction, exclusive of time for pupils to do homework in class, varies between 25-32 minutes in the primary grades, between 27-28 minutes in grades four through six, and between 24-27 minutes in grades seven and eight.

School Organization

Teachers were asked to indicate the type of school organization in which they teach mathematics. They responded by checking one of three categories: (1) to one group of pupils (even if split grade) in a self-contained classroom; (2) to several classes or grade levels in a departmentalized organization; (3) other. Theie response frequencies are shown in Table 15 below.

TABLE 15

Type of Instructional Organization

Type of School Organization	No. of Teachers Reporting Set A	Set B	χ^2	d.f.	Significance of Difference
Self-contained classes	166	169			
Departmentalized	13	30	5.87	2	n.s.
Other	18	23			

Class Size

Teachers were asked to report the total number of pupils to whom they teach mathematics. They were also asked to record the total number of classes to which they teach math, considering a split grade in one room as a single class. From these data, mean class sizes were calculated in our data processing operation, and the results are displayed in Table 16.

TABLE 16

AVERAGE SIZE OF MATH CLASSES

Grade Category	Mean Class Size Set A	Set B	t	d.f.	Significance of Difference
1-3	23.8	23.7	0.23	174	n.s.
4-6	27.6	27.7	0.14	104	n.s.
7-8	28.5	27.2	1.35	75	n.s.

Differences in means were minor and were not statistically significant at any grade level. Clearly, differences in class size do not account for differences in math achievement between the two sets of schools.

Pupil Promotion and Retention

As responses to the second statement in Table 12 (page 85) show, teachers in low-achieving schools do not differ from those in high-achieving schools with respect to their perceptions of their schools' promotion policies. It should be noted, however, that the mean response of all teachers is between two and three on a scale from one to five. Their

responses to this item suggest that the majority of all these teachers believe that pupils are too often promoted from one grade to another when their achievement in mathematics is not at, or very near, grade level.

Pupils in grades five through eight were asked to indicate whether or not they had ever repeated a grade because they were not promoted to the next grade. If a pupil checked "yes," he was asked to check which grade (or grades) he had repeated. The results are shown in Table 17.

TABLE 17

INCIDENCE OF RETENTION IN THE TWO SETS OF SCHOOLS

School Math Characteristic	Retained in Grade		Total
	Yes	No	
High-achieving (Set A)	637	2395	3032
Low-achieving (Set B)	606	2132	2738
Total	1243	4527	5770

Note: A chi-square value of 1.08, obtained from data shown in the table above, with one degree of freedom, is not statistically significant.

Twenty-one percent of all pupils in grades five through eight in high-achieving schools reported having been retained in grade at least once during their school careers; the comparable figure for low-achieving schools was 22%. A chi-square test of the data shown in Table 17 indicates that the two sets of schools do not differ in the total portion of pupils who are retained. But as Table 18 shows, they do differ with respect to the

the particular grade levels at which retentions occur.

TABLE 18

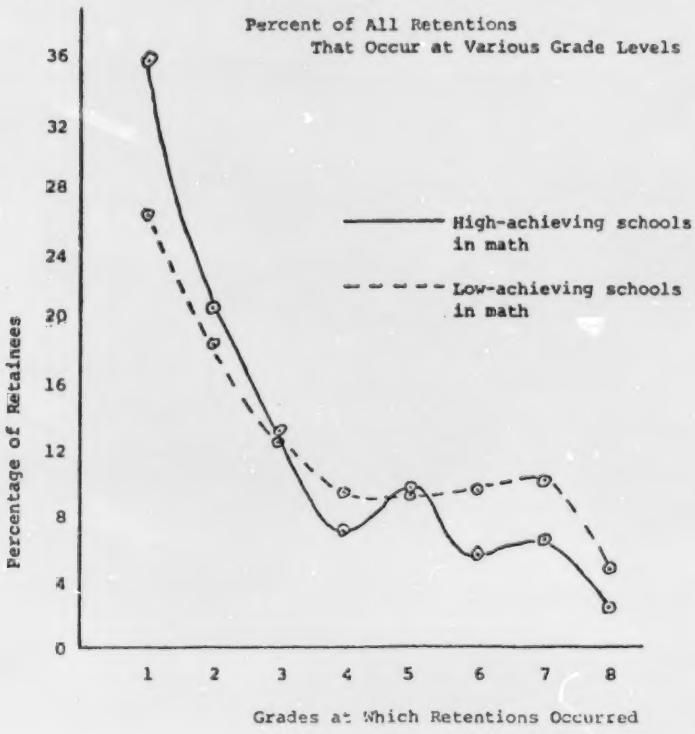
GRADE LEVELS AT WHICH PUPILS WERE RETAINED IN SCHOOLS THAT WERE HIGH-ACHIEVING AND LOW-ACHIEVING IN MATH

Grade Level at Which Retentions Occurred	School Math Achievement				Difference in Percent	Total
	High-Achieving		Low-Achieving			
	No.	%	No.	%		
1	256	35.8%	202	26.2%	+9.6%	458
2	147	20.6	142	18.4	+2.2	289
3	93	13.0	96	12.4	+0.6	189
4	49	6.9	74	9.6	-2.7	123
5	69	9.7	73	9.5	+0.2	142
6	40	5.6	74	9.6	-4.0	114
7	45	6.3	77	10.0	-3.7	122
8	15	2.1	33	4.3	-2.2	48
Total	714	100.0%	771	100.0%		1,485

An inspection of Table 18 reveals that high-achieving schools retain a larger percentage of pupils in the first two grades and a smaller percentage of pupils in the three upper grades than do the low-achieving schools. The effects of these differences are shown graphically in Figure 1 on the following page.

A chi-square test of the difference in the retention practices in the two types of schools (data from Table 18) yielded a chi-square value of 34.86; a value of only 24.32 (with 7 degrees of freedom) is required for rejection of the null hypothesis at the 0.001 level of significance. Hence, the inference that the two sets of schools differ in retention practices

Figure 1



is warranted. Compared with schools with lower achievement in math, schools with higher achievement retain a larger percent of pupils in the first two grades and a smaller percent of pupils in the last three grades. The schools do not differ significantly in retention practices in grades three, four, and five. These findings suggest that schools that retain pupils, especially in cases in which promotion may be questionable, in the primary grades will reduce the need for retention in the upper elementary grades. In addition, these early retentions may contribute to superior achievement in math by the time pupils complete eighth grade.

Teacher Variables

Questionnaires administered to teachers called on them to respond to two items having to do with their interest in teaching math and to two items relating to their perceived difficulty with teaching math. Pupils were asked to rate their perceptions of their teachers' interest in teaching math. Teachers responded to two items to indicate their expectations for pupil achievement. Teachers were asked to record all types of teaching certificates and endorsements they hold; their present teaching assignments; credits earned in high school mathematics, college mathematics, and methods of teaching mathematics. Finally, pupils were asked to respond to four questionnaire statements to register their perceptions of their teachers' nurturance and acceptance of pupils. Results of this data collection are presented and discussed categorically below.

Teacher Interest In and Difficulty With Teaching Math

Interestingly enough, teachers in low-achieving schools indicated they they have no less interest in teaching mathematics than do their counterparts in the high-achieving schools. In responding to the statement, "Math is one of the most interesting school subjects for me to teach," on a scale from one to five (corresponding to "strongly disagree" to "strongly agree," respectively) the mean rating of teachers in each set of schools was approximately 3.9, indicating general agreement with the statement (see Table 19 on the next page). Conversely, in responding to the statement, "Math is one of the least interesting school subjects for me to teach," teachers in each set of schools gave a mean rating of about 1.7, which translates into a reaction somewhere between "disagree" and "strongly disagree." Pupils' ratings were consistent with the responses

TABLE 19

TEACHER RATINGS OF TEACHER VARIABLES

Statement	Grades	Mean Rating Set A	Mean Rating Set B	t	d.f.	Significance of Difference
Math is one of the most interesting school subjects for me to teach.	1-3	3.641	3.633	0.05	174	n.s.
	4-6	3.961	4.327	1.97	104	n.s.
	7-8	4.282	4.158	0.54	75	n.s.
	K-8	3.874	3.928	0.50	419	n.s.
Math is one of the least interesting school subjects for me to teach.	1-3	1.923	1.969	0.29	174	n.s.
	4-6	1.608	1.346	1.49	104	n.s.
	7-8	1.282	1.553	1.33	75	n.s.
	K-8	1.663	1.739	0.78	419	n.s.
Math is one of the most difficult school subjects for me to teach.	1-3	2.167	2.061	0.65	174	n.s.
	4-6	1.961	1.800	0.67	104	n.s.
	7-8	1.461	1.684	1.13	75	n.s.
	K-8	1.925	1.914	0.10	419	n.s.
Math is one of the least difficult school subjects for me to teach.	1-3	3.372	3.429	0.30	174	n.s.
	4-6	3.686	3.564	0.47	104	n.s.
	7-8	4.000	3.658	1.12	75	n.s.
	K-8	3.628	3.540	0.69	419	n.s.
There seems to be very little that can be done to improve the achievement of children who have persistent problems with learning mathematics.	K-8	2.030	2.266	2.44	419	$p < .02$
I am confident that nearly all of my pupils who have persistent problems in learning math could learn reasonably well if the school could determine the natures of their problems and devise instructional strategies geared to their individual styles of learning.	K-8	3.814	3.707	1.10	419	n.s.

of their teachers. In responding to the statement, "From things my teacher says and does, I know that my teacher really enjoys teaching math," pupils in each set of schools gave their teachers a mean rating of 3.8, which does not differ statistically from the teachers' mean rating of 3.9. The reader is referred to the first statement appearing in Table 24 on page 101. Data in Table 19 indicate that teachers of upper elementary grades find the teaching of mathematics somewhat more interesting than do teachers of the lower grades. The differences are not great, but in the extreme, the responses of teachers of grades seven and eight were significantly higher, from a

statistical point of view, than those of teachers of grades one through three. Nevertheless, the mean response of the latter was still about 3.6 compared with about 4.2 for the former, which still suggests a fairly strong interest in teaching mathematics among primary grade teachers.

Teachers' responses to statements having to do with the difficulty of teaching math closely paralleled their responses to their interest in teaching it. The mean ratings to the statement, "Math is one of the most difficult school subjects for me to teach," in the two sets of schools were the same, 1.9, which translates into "disagree." Again, perceived difficulty with teaching math decreases somewhat among teachers from lower to higher grades. The responses of teachers of grades seven and eight were statistically different from those of teachers of grades one through three in both sets of schools; but again, the differences were not large from a practical standpoint.

Teachers' responses in this study, corroborated by pupils' ratings, dispell a myth concerning the reactions of elementary school teachers to the teaching of mathematics. Data collected in this investigation indicate that elementary school teachers by no means find the teaching of mathematics to be uninteresting, compared with other school subjects, nor do they find it especially difficult to teach. These findings hold equally well for teachers in schools in which pupil achievement in math is low, as measured by the Basic Skills Test, as for teachers in schools in which pupil achievement in math is high. Clearly, teacher interest, or lack thereof, and perceived difficulty with teaching math do not account for differences in math achievement in the two sets of schools. This is not to say that

these factors have no effect on pupil achievement; they may well have a strong influence within an individual classroom. This investigation did not use the classroom as a unit of analysis. These findings tell us only that these factors do not explain achievement differences between two sets of several schools, in which considerable variation may exist exist among schools, teachers, and classrooms.

Teacher Expectations for Pupil Achievement

Two statements on the teacher questionnaire were designed to assess teachers' attitudes about the potential for achievement of pupils who appear to have persistent problems with learning math. The reader is referred to the last two statement appearing in Table 19 (page 94). The first statement represents a negative attitude, or at least an attitude of futility. The second statement represents a positive attitude, or one of confidence that achievement by pupils with learning problems is to some extent possible if the natures of their learning problems were known and if instructional strategies suitable for individual styles of learning were developed and used. One attitude says, in effect, "there is not much point in laboring too hard or too long with certain pupils for they will never achieve much in math." The other says, "Don't give up on either hope or effort; some further achievement is always a possibility."

Generally, teacher responses show that the negative attitude is somewhat stronger in the low-achieving schools and the positive attitude is slightly more prevalent in the high-achieving schools. Although rating differences between the two sets of schools are not large, the difference in responses to the statement expressing the negative attitude was statistically significant at the 0.02 level. It would be inaccurate to describe

high-achieving schools as having teachers with positive attitudes and low-achieving schools as having negative attitudes. Both attitudes exist to some extent in both types of schools. It would probably not be inaccurate to conclude that the low-achieving schools in this study have a slightly greater percentage of teachers with negative attitudes than do the high-achieving schools. Said another say, among the high-achieving schools one would expect to find a somewhat larger percentage of teachers, than in the low-achieving schools, who believe pupils' learning problems are correctable.

Teacher Certification

Based on information supplied by teachers as to the types of teaching certificates and endorsements they hold and on information about their current teaching assignments, each of 358 teachers was classified as holding appropriate or inappropriate certification for his or her present teaching assignment. Table 20 below does not include 63 teachers (31 from Set A and 32 from Set B) because information regarding certification and/or teaching assignment was unclear or not furnished.

TABLE 20

CERTIFICATION STATUS OF TEACHERS

Certification Status	No. of Teachers Set A	No. of Teachers Set B	χ^2	d.f.	Significance of Difference
Certification appropriate for present teaching assignment	151	175	0.17	1	n.s.
Teaching on permit, interim certificate, or without appropriate endorsement	16	16			

The two sets of schools differed slightly in the certification status of their teachers, but as Table 19 shows, a chi-square test did not demonstrate the difference to be statistically significant. Among the high-achieving schools (Set A), 9.6% of the teachers did not hold appropriate certificates and endorsements for their teaching assignments. Among low-achieving schools (Set B), the corresponding figure was 8.4%.

A separate analysis was done to determine whether teachers of various grade levels differ in certification status. They did. Among seventh and eighth grade teachers in both sets of schools combined, 17.1% of them were not appropriately certified for their present teaching assignment whereas 6.7% of the teachers of lower grades were inappropriately certified. By use of a chi-square test, it was found that these differences were significant at the 0.01 level of confidence. In many of the cases, teachers were teaching seventh or eighth grade on a secondary certificate without endorsement in mathematics and without elementary certification.

Academic and Professional Preparation

Teachers in the two sets of schools differed in the number of courses in methods of teaching mathematics included in their professional preparation. As Table 21 shows, significant differences did not exist between the two sets of primary grade teachers or between the two sets of seventh and eighth grade teachers, but the difference between the two sets of teachers of grades four through six was significant at the 0.01 level. Teachers in low-achieving schools above the primary level reported, on the average, one-half a course more credit in methods of teaching mathematics than did their counterparts in high-achieving schools. This effect was sufficiently strong that, when a t-test was done to include all teachers (K-8), the

TABLE 21

TEACHER PREPARATION IN METHODS OF TEACHING ARITHMETIC/MATHEMATICS

Grade Level	Mean No. of Courses Set A	Set B	t	d.f.	Significance of Difference
1-3	1.95	1.88	0.46	173	n.s.
4-6	1.58	2.09	2.58	103	$p < .01$
7-8	1.49	1.89	1.75	75	n.s.
K-8	1.73	1.94	1.96	355	$p = .05$

difference in the means of teachers in the two sets of schools was significant at the 0.05 level.

All teachers were asked to report the number of years of high school math completed and the number of quarter hours of credit they earned in college mathematics. The results are presented below in Tables 22 and 23.

TABLE 22

TEACHER BACKGROUND IN COLLEGE MATHEMATICS

Grade Level	Math Credits (qtr. hr.) Set A	Set B	t	d.f.	Significance of Difference
1-3	9.2	8.5	0.79	172	n.s.
4-6	7.7	7.9	0.16	101	n.s.
7-8	11.6	8.8	1.68	75	n.s.
K-8	9.3	8.4	1.37	352	n.s.

TABLE 23

TEACHER BACKGROUND IN HIGH SCHOOL MATHEMATICS

Grade Level	Average Number Years Completed		t	d.f.	Significance of Difference
	Set A	Set B			
1-3	3.03	2.97	0.39	174	n.s.
4-6	3.20	3.07	0.76	104	n.s.
7-8	3.18	3.00	0.91	75	n.s.
K-8	3.11	2.97	1.48	359	n.s.

Tables 22 and 23 show that teachers in the high-achieving schools reported a slightly more extensive academic background in both high school and college mathematics than teachers in the low-achieving schools. However, in no case was the difference great enough to be statistically significant.

Teacher Nurturance and Acceptance of Pupils

Pupils were asked to respond to four statements to indicate their perceptions of certain teacher behaviors related to nurturance and acceptance of pupils. Ratings were on a five-point scale ranging from strongly disagree (1) to strongly agree (5). The statements are reproduced as the last four items in Table 24 on the following page.

As Table 24 shows, pupils differed in their perceptions of teacher behaviors described by two of the four statements. According to pupils, teachers in high-achieving schools more often or more strongly offer encouragement to pupils to keep trying in the face of difficulties with math and they more often provide public recognition for success in math

TABLE 24

PUPIL RATINGS OF TEACHER VARIABLES

Statement	Grades	Mean Ratings Set A	Mean Ratings Set B	t	d.f.	Significance of Difference
From things my teacher says and does, I know that my teacher really enjoys teaching math.	5-8	3.855	3.808	1.39	5766	n.s.
If I have trouble with something in math, my teacher makes sure I get the help I need to understand it.	5-8	4.393	4.344	1.77	5777	n.s.
If I have trouble with something in math, my teacher says or does something that makes me want to keep trying and not give up.	5-8	3.946	3.878	2.04	5772	$p < .05$
When I do well at something in math, my teacher says something about it so that my classmates hear it.	5-8	3.106	2.984	3.11	5761	$p < .01$
My math teacher likes me even when I do not do my very best in math.	5-8	3.521	3.583	1.66	5754	n.s.

than do teachers in low-achieving schools. They did not differ in their perceptions of the extent to which their teachers ensure that pupils get the help they need to understand math with which they experience some difficulty. Neither did they differ in their perceptions of their teachers' acceptance (liking them) of them even when they do not do their best in mathematics.

Pupil Variables

On the teacher questionnaire, teachers were asked to rate the general preparedness of pupils in their classrooms at the beginning of the year in their mastery of the particular concepts and skills needed to master the objectives for their present grade level. Both teachers and pupils rated statements having to do with pupil motivation. Pupils supplied information about their attendance in nursery school and kindergarten, and they reacted to items relating to their personal interest in mathematics as a school subject and to the attitudes of their peers toward pupils who do well in math. On none of these variables were the two sets of schools distinguishable from each other. Nevertheless, some of the data are instructive and are presented and discussed below.

Pupil Preparedness

On a five-point scale from strongly disagree (1) to strongly agree (5), teachers rated the preparedness at the beginning of the year of their pupils as a group in the prerequisite skills and concepts needed for success in math during the year. Not only did teachers in all grade levels, collectively, in the two sets of schools not differ from each other in their ratings of this statement, there were no differences between teachers in the two sets of schools at any of the grade categories shown in Table 25 on the following page.

It is worth noting that none of the mean ratings of the second statement in Table 25 exceeds a value of three by more than a tenth of a point. A rating of 2.0 was coded disagree; one of 3.0 meant uncertain; and one of 4.0, agree. Teachers at all grade levels, including grades

TABLE 25

TEACHER RATINGS OF PUPIL VARIABLES

Statement	Grades	Mean Ratings Set A	Mean Ratings Set B	t	d.f.	Significance of Difference
Most of my pupils are sufficiently motivated to learn mathematics.	1-3	3.590	3.684	0.67	174	n.s.
	4-6	3.431	3.382	0.23	104	n.s.
	7-8	3.282	3.237	0.20	75	n.s.
	K-8	3.487	3.563	0.76	419	n.s.
Although a brief review may be in order, nearly all of my pupils began the year with a mastery of the particular mathematical concepts and skills needed to master the objectives for their present grade level.	1-3	3.103[a]	3.153[b]	0.29	174	n.s.
	4-6	2.843	2.491[b]	1.46	104	n.s.
	7-8	2.410[a]	2.553[b]	0.51	75	n.s.
	K-8	2.874	2.878	0.03	419	n.s.

[a]In Set A, responses of teachers of grades 7-8 differ from those of teachers of grades 1-3 ($t = 3.07$, $df = 115$, $p < .01$).

[b]In Set B, responses of teachers of grades 4-6 differ from those of teachers of grades 1-3 ($t = 3.14$, $df = 151$, $p < .01$) and also from those of teachers of grades 7-8 ($t = 2.54$, $df = 134$, $p < .05$).

one through three, seem to be saying that their pupils at the beginning of the year are not well prepared generally to undertake successfully the mastery of math objectives for their present grade. Not unexpectedly, teacher ratings of pupil preparedness generally decreased with an increase in the grade level at which teachers teach. As the footnote to Table 25 indicates, differences among teachers at different grade levels within the same set of schools are significant.

Ratings by pupils of each of seven statements related to pupil variables were virtually identical for the two schools (see Table 26). Certainly none of the differences was significant. The motivation expressed by pupils to learn math and to earn good grades were especially high. In both sets of schools, a significantly greater number of pupils reported more pupils look up to and respect kids who do well in math than who look down on or make

TABLE 26

PUPIL RATINGS OF PUPIL VARIABLES

Statement	Grades	Mean Ratings Set A	Mean Ratings Set B	t	d.f.	Significance of Difference
I want to learn as much math as I can and as well as I can.	5-8	4.603	4.604	0.06	5771	n.s.
I want to get good grades in math.	5-8	4.878	4.896	1.19	5766	n.s.
I don't really care about my grades in math.	5-8	1.254	1.235	0.83	5770	n.s.
My classmates respect and look up to kids who do well in math.	5-8	3.270	3.240	0.81	5715	n.s.
My classmates look down on or make fun of kids who do well in math.	5-8	2.046	1.999	1.38	5713	n.s.
Math is one of my most favorite subjects.	5-8	3.266*	3.312*	1.04	5721	n.s.
Math is one of my least favorite subjects.	5-8	2.662*	2.605*	1.30	5723	n.s.

*In both sets of schools, pupil responses to these two items differed ($t = 13.5$ for Set A and $t = 16.5$ for Set B; $p < .001$ for both sets.)

fun of them. And encouragingly, in both sets of schools a significantly greater proportion of pupils report that math is one of their most favorite subjects than who report it to be one of their least favorite subjects. Generally, if pupil ratings are accepted as valid and reliable, it appears that pupil motivation, interest in math, and their attitudes toward successful achievement in math are positive and fairly strong among the low-achieving schools as well as mong the high-achieving ones.

Pre-school Experience

Pupils were asked to indicate on their questionnaires whether or not they attended nursery school or Head Start before entering kindergarten or first grade. In order to help teachers answer pupils' questions as to what a nursery school is or is not, for purposes of this study, teachers were

provided a guideline that defined a nursery school as one that emphasizes cognitive, social, or emotional growth and is staffed by, or is at least under the direction of a professionally trained person--not one that is essentially custodial or day care in nature.

TABLE 27

NURSERY SCHOOL ATTENDANCE BY PUPILS IN THE TWO SETS OF SCHOOLS

Characteristic	Attended Nursery School or Head Start		Total
	Yes	No	
High-achieving (Set A)	668	2083	2751
Low-achieving (Set B)	694	2346	3040
Total	1362	4429	5197

Note: Data from the above table yield a chi-square value of 1.62 (with 1 degree of freedom), which is not statistically significant.

As Table 27 shows, slightly less than 25% of all pupils who were in the fifth through eighth grade in 1979-80 reported attending nursery school--24.3% of the pupils from high-achieving schools and 22.8% of those from low-achieving schools. A chi-square test revealed that the two sets of schools are not distinguishable from each other on the basis of the proportion of upper elementary pupils who attended nursery school or Head Start.

Table 28 (next page) shows the number of fifth through eighth grade pupils in each set of schools who reported that they attended kindergarten. The portion of pupils from high-achieving schools who reported having

TABLE 28

KINDERGARTEN ATTENDANCE BY PUPILS IN

THE TWO SETS OF SCHOOLS

School Characteristic	Attended Kindergarten		Total
	Yes	No	
High-achieving (Set A)	1827	924	2751
Low-achieving (Set B)	1971	1069	3040
Total	3798	1993	5791

Note: Data from the above table yield a chi-square value of 1.52 (with 1 degree of freedom), which is not significant statistically.

attended kindergarten was 66.4% and from low-achieving schools the portion was 64.8%. For all schools combined, the portion of kindergarten attendees was 65.6%, a value that will be referred to again soon. A chi-square test informs us that the two sets of schools do not differ with respect to the proportion of their pupils who attended kindergarten. These findings do not necessarily mean that pre-school experience has no influence on later achievement. It is possible that the effects of pre-school experience influenced both sets of pupils in the same direction and in about the same magnitude, especially since the percentages of pre-school attendees in the two sets of schools were virtually identical. In fact, data collected about the same time from another source, described below, indicates that this possibility is a near certainty.

Data on kindergarten attendance were collected on a statewide basis when the Basic Skills Test was administered to over 64,000 eighth grade

pupils in the public schools of Tennessee in April, 1980. On each test answer sheet, a pupil taking the test was asked to respond to the question, "Did you attend kindergarten?" by blackening a circle labeled "Yes" or one labeled "No." The typical eighth grader in 1979-80 was of age for kindergarten attendance in the school year 1971-72.

The score of each pupil was reported by the Tennessee Testing and Evaluation Center as the number of test items answered correctly. Separate scores were reported for each of the four sub-tests of mathematics, spelling, language, and reading. Separate mean scores on each sub-test were determined for all pupils who attended kindergarten and for those who did not. For purposes of statistical analyses, the standard deviation associated with each mean was also determined so that a t-test could be carried out to test the null hypothesis that the achievement scores of pupils who attended kindergarten does <u>not</u> differ from those of pupils who did not attend kindergarten.

Data used to test the null hypotheses are presented in Table 29 on the following page. The mean scores, their difference, the t-values associated with the differences, and the statistical significance of the difference is shown for each of the four sub-tests.

It should be noted that 66.0% of all eighth grade pupils (of 1979-80) throughout the state reported having attended kindergarten. Among the schools selected for the math achievement study, the portion was 65.5%. Hence, it would appear that pupils in this study sample were representative of the state population so far as kindergarten attendance is concerned.

Table 29

Achievement Data on Pupils With and Without Kindergarten Experience

Sub-test	Possible Score	Attended Kindergarten Yes	Attended Kindergarten No	Difference Absolute	Difference Percent	t-value*	Significance
Mathematics	76	54.356	51.070	3.286	6.4%	25.5	<.001
Spelling	24	19.473	18.707	0.766	4.1%	12.3	<.001
Language	56	38.125	35.444	2.681	7.6%	29.0	<.001
Reading	44	36.296	34.833	1.463	4.2%	21.7	<.001
Total Test	200	148.250	140.054	8.196	5.8%	**	**
No. of Pupils		42,588	21,948				
Percent of Pupils		66.0%	34.0%				

* A t-value of only 3.29 was necessary to reject the null hypothesis at the 0.001 level of significance.

** A t-value for total score could not be determined because standard deviations for total score were not requested from the Testing and Evaluation Center. Our primary interest was with differences in sub-test mean scores.

The results shown in Table 29 demonstrate that achievement of pupils with kindergarten background is superior to that of non-kindergarten pupils in mathematics, in spelling, in language, and in reading. The effect was greatest for mathematics and for language, less for reading and spelling. The Basic Skills Test administered in April, 1980, assessed achievement with respect to 19 of the 30 objectives (less than two-thirds) defined by the state as minimal basic skills competencies in mathematics. One must assume some advantage on behalf of kindergarten attendees on the eleven unmeasured objectives and on a broad domain of math objectives extending beyond the 30 basic skills objectives.

To this point no causal relationship has been inferred between test score differences and kindergarten attendance. Indeed, caution is called for in drawing such an inference. Two hypotheses come to mind that may account for differences in test scores:

> Hypothesis A: Test score differences are the effects of gains in cognitive, affective, and motor skill development that result from kindergarten experience.
>
> Hypothesis B: Test score differences are the effects of socio-economic status; that is, to the effects of the nurturance, encouragement, and the value placed on educational achievement, all of which are typically more characteristic of homes of higher socioeconomic status than of homes of lower socioeconomic status.

Evidence that is presently available is insufficient to fully establish the validity of either hypothesis. It is possible, even probable, that the effect is in part explainable by both hypotheses.

It has been argued that parents who place high value on educational achievement and who are convinced of the value of pre-school learning experiences are more likely than others to provide the kindergarten option for their children. Some of these parents may have paid tuition for private kindergarten because of geographical convenience or lack of availability (in 1971-72) of a public kindergarten program. In 1971-72 it was necessary in many school districts for parents to provide private transportation for their kindergarten children. These efforts required a commitment to the value of pre-school education. And the parents who made these efforts are likely also to be ones who nurture, encourage, and instill in their children the values that contribute to educational achievement throughout their school career.

There is clearly some argument in favor of the socioeconomic hypothesis. The argument is weakened, however, by the fact that 66% of the total eighth grade population attended kindergarten. The upper and upper-middle socio-economic classes of families represent far less than two-thirds of all families.

In seeking further evidence of the effects of kindergarten attendance, another analysis was carried out using data from the 5,795 pupils from both the selected high and low-achieving schools of this study. In addition to reporting whether or not they attended kindergarten, pupils also indicated whether or not they had ever repeated a grade because of failure to be promoted. As reported earlier, high and low-achieving schools did not differ with respect to their overall incidence of pupil retention (Table 17, page 90), although they did differ in the grade levels at which retentions occur (Table 18, page 91). However, when the incidence of grade retention was related to kindergarten attendance, a positive effect of kindergarten attendance became apparent. This positive effect may also be due in part to socioeconomic factors as well as to the direct influence of kindergarten experiences. Data are presented in Table 30 on the following page.

A chi-square test for the fifference in the incidence of retention of pupils who did and who did not attend kindergarten yielded a chi-square value of 131.8. But a value of only 10.83 is required (with one degree of freedom) to reject the null hypothesis at the 0.0001 level of significance. Indeed, the tabled data are so lop-sided that a statistical test was scarcely needed to confirm the significance of the findings. The results presented in Table 30 are described narratively in the following four paragraphs.

Table 30

Actual and Expected Incidence of Grade Retention
Among Pupils Who Did and Who Did Not
Attend Kindergarten

Retention Status	Frequency*	Kindergarten Attendance Yes		No		Total
Retained in at Least One Grade	Actual	639	(16.8%)	595	(29.8%)	1,234
	Expected	809	(21.3%)	425	(21.3%)	
Never Retained in Grade Level	Actual	3,162	(83.2%)	1,399	(70.2%)	4,561
	Expected	2,992	(78.7%)	1,569	(78.7%)	
TOTAL		3,801	(65.6%)	1,994	(34.4%)	5,795

* Actual frequencies represent the incidence of retention and lack of retention reported by 5,795 pupils in grades five through eight in April, 1980. Expected frequencies represent the incidence of retention and lack of retention that would be expected if there were no difference in the incidences of retentions between pupils with kindergarten experience and those without it.

Of those pupils who attended kindergarten:

(1) It would be expected that 21.3% of them would be retained in at least one grade if there were no difference in retention rates of pupils with and without kindergarten experience. In actuality, only 16.8% of them were retained in at least one grade. This means that 21% fewer of these pupils than expected have been retained in grade level. (639 is 21% less than 809.)

(2) It would be expected that 78.7% of them would never have been retained in grade if there were no difference in retention rates of pupils with and without kindergarten experience. In fact, 83.2% of them were never retained in grade. This means that nearly 6% more of these pupils than expected have never been retained in grade. (3,162 is 6% greater than 2,992.)

Of those pupils who did NOT attend kindergarten:

(3) It would be expected that 21.3 % of them would be retained in at least one grade if there were no difference in retention rates of pupils with and without kindergarten experience. Results show that 29.8% of these pupils were retained in at least one grade. This means that 40% more of these pupils than expected have been retained in grade. (595 is 40% greater than 425.)

(4) It would be expected that 78.7% of them would never have been retained in grade if there were no difference in retention rates of pupils with and without kindergarten experience. In reality, only 70.2% of them were never retained in grade level. This means that 11% fewer of these pupils than expected have never repeated a grade. (1,399 is 11% less than 1,569.)

To summarize, the high and low-achieving schools of this study did not differ from each other with respect to nursery school or kindergarten attendance of their pupils. Other evidence indicates clearly, however, the positive effects of kindergarten on later pupil achievement in mathematics, as well as on three other basic skills subjects, and on the reduction of non-promotions of pupils in later grades. In addition, the evidence strongly suggests that these effects are attributable to some extent to the direct influence of kindergarten experiences over and beyond any effects due to socioeconomic advantages. It should be noted that the positive effects shown in Tables 29 and 30 derive from an analysis based on using individual pupils as units of study whereas the null effects demonstrated by Table 28 result from the use of the school as a unit of analysis. This is another incidence in which the use of the school as the unit of analysis appears to obscure positive effects that may be demonstrable by using the classroom or individual as the unit of analysis.

Parental/Community Variables

The major thrust of this investigation was to identify school-related variables that distinguish high and low-achieving schools from each other. Consequently, the study of non-school factors was extremely limited. The teacher questionnaire sought teachers' perceptions of their communities' expectations of math programs and of parental support, encouragement, and reinforcements of schools' efforts. The pupil questionnaire asked pupils to react to statements having to do with parental interest in pupils' achievement and their ability and willingness to assist their children when assistance is needed.

On none of these factors did the ratings of the two sets of pupils or teachers differ. The statements and the mean ratings of teachers and of pupils are presented in Tables 31 and 32 below and on the following page.

TABLE 31

TEACHER RATINGS OF COMMUNITY/PARENTAL VARIABLES

Statement	Grades	Mean Ratings Set A	Mean Ratings Set B	t	d.f.	Significance of Difference
Our school's program in mathematics is just as good as parents and the community expect it to be.	K-8	3.296	3.270	0.29	419	n.s.
Most parents encourage their children in my class(es) to achieve in mathematics, and they support and reinforce my efforts to bring about pupil achievement.	K-8	3.186	3.302	1.08	419	n.s.

TABLE 12

PUPIL RATINGS OF COMMUNITY/PARENTAL VARIABLES

Statements	Grades	Mean Ratings Set A	Mean Ratings Set B	t	d.f.	Significance of Difference
My parents are interested in knowing that I've done my best to complete my math homework.	5-8	4.586	4.630	1.83	5721	n.s.
My parents expects more of me in math than I can really do.	5-8	2.735	2.805	1.65	5727	n.s.
My parents don't care what grades I get in math so long as I pass.	5-8	1.678	1.683	0.17	5717	n.s.
My parents are interested in knowing how I do on math quizzes and tests.	5-8	4.412	4.420	0.27	5707	n.s.
My parents don't really care if I pass or fail in math.	5-8	1.347	1.303	1.68	5722	n.s.
If I wanted to have my homework checked to see if I had done it correctly, someone at home would be <u>able</u> to check it for me.	5-8	4.029	4.006	0.63	5735	n.s.
If I wanted to have my homework checked to see if I had done it correctly, someone at home would be <u>willing</u> to check it for me.	5-8	4.110	4.115	0.16	5732	n.s.
If I should need help with my math homework, someone at home would be <u>able</u> to help me.	5-8	4.301	4.267	1.11	5720	n.s.
If I should need help with my math homework, someone at home would be <u>willing</u> to help me as much as they can.	5-8	4.455	4.462	0.99	5715	n.s.

Not only were the means of the two sets of ratings not sufficiently large to be statistically significant, in most instances they were nearly identical. While parental interest in and active support of pupil achievement may indeed have a positive effect on achievement, its effect on math achievement in one set of the selected schools appears not to differ from its effect on the other set. Certainly it is untrue that high-achieving schools are characterized by strong parental interest and support while weak interest and support are prevalent among parents of pupils in

low-achieving schools. As the mean ratings shown in Table 31 indicate, pupils in both sets of schools gave rather high ratings to their parents' interest in their achievement and to their willingness and ability to help them with math homework when needed. On a five-point scale from strongly disagree (1) to strongly agree (5), their mean ratings on all of these items were above 4.0, which represents agree. Teachers, on the other hand, were slightly less generous than pupils in rating parental encouragement of pupils' efforts in math and their support and reinforcement of teachers' efforts to bring about pupil achievement. Such a difference in the perceptions of pupils and teachers is perhaps not unexpected.

CHAPTER VI

SUMMARY AND INTERPRETATIONS

This report completes the first phase of a multi-phase research effort by the Tennessee Department of Education to identify school-related variables that influence pupil achievement, as measured by the results of the Basic Skills Test. The first phase of the research has been concerned with achievement in mathematics. Later phases will deal with achievement in reading and in language arts. Schools that participated in this phase of the research were selected on the basis of the results of the Basic Skills Test, administered in April of 1979, which served also as the criterion measure of pupil achievement.

The Research Design

The design of the research study called for the pairing of schools which differed markedly in mathematics achievement but which were nearly identical with respect to achievement scores in reading and also in language. Sixteen pairs of schools containing an eighth grade, along with their feeder schools, were selected for the study, making a total of 48 schools. Objective criteria were applied in the selection of these school from among 690 public schools in the state that contain an eighth grade. In addition to similarities in reading scores and in language scores and large differences in mathematics scores, schools were matched on the basis of comparable size of pupil population and on the number of feeder schools.

The process of school matching resulted in the selection of two sets of schools with distinct and desirable characteristics for our research purposes.

They also were representative of the total population of state public schools so far as pupil achievement characteristics are concerned. Neither set of schools differed from all public schools in the state in reading achievement scores or in language achievement scores. Neither did the two sets of schools differ from each other on these two measures. However, in mathematics achievement, the mean scores of the set of high-achieving schools were significantly higher than those of the set of low-achieving schools. In addition, both sets of schools differed significantly, either in being higher or lower, from the mean of all public schools in the state. But when the math achievement scores of the high and low-achieving schools were pooled to form a single set, the mean achievement score of that set did not differ from the mean of all public schools.

Although there is reason to believe the schools selected for the study were representative of schools statewide with respect to their achievement scores, the types of communities they serve are not representative of Tennessee communities generally. With one exception, the selected schools serve rural communities and small towns. Patterns of test scores would have made it possible to include eighth grade schools in the hearts of Tennessee's larger cities. But because of the variety of school organizations, differences in school size, zoning and intra-city busing, the problems of identifying all the feeder schools and then isolating or controlling the many variables that surely exist among the feeder schools would have rendered the research unmanageable. The importance of studying these schools is recognized. Our present thinking is to treat the findings of this research as hypotheses to be tested under conditions in which selected variables can be controlled or isolated. In such follow-up research, it should be possible not only to

include schools in Tennessee's larger cities but also to subject the findings of this research to a more rigorous test than has been possible to date.

Major Limitations of the Study

This study was delimited, for the most part, to school-related variables, that is, to variables that are alterable by schools at the local level or by the reformulation of public policy. It was also delimited to a study of only those variables that previous research or experienced observers within the state suggest may influence mathematics achievement specifically. Beyond these delimitations, there are two major limitations that require emphasis because their effect has implications for interpreting the findings of the study.

One major limitation was the necessity to assume that characteristics of individual schools have remained fairly stable over a period of about eight years. The achievement measured by the Basic Skills Test, which was used as the criterion measure in the study, did not occur during the time the study was underway; much of it did not occur even during the preceding year. Instead, the test, which was administered to eighth graders in April, 1979, measured achievement that had occurred incrementally over a period of several years. On the other hand, the measures of variables that may be associated with math achievement reflect conditions, practices, and characteristics found in the selected schools in the Spring of 1980. To the extent that these variables, as they existed when measured, differ from what they were during the period of pupil achievement, then to that extent will any associations between the dependent variables and pupil achievement be misleading. The assumption of variable stability may be reasonable for some schools; for others it may not be. The necessity of operating on the basis

of this assumption makes it imperative that some of the findings of this investigation be regarded as hypotheses to be tested under more rigorous conditions. The limitation just described, however, would not apply to static variables, such as pre-school experience. Once a pupil enters first grade, his having or not having pre-school experience does not change.

A second major limitation of the study resulted from the requirement of using the school, not the classroom or individual pupil, as the unit of analysis. This limitation was imposed because the criterion measures, scores on the Basic Skills Test, were available for schools but not for classes. Moreover, pupils were in different classes, often in different schools, when the research was carried out from the ones they were in when the test was administered. These constraints resulted from the planning of the research *ex post facto*, six months after the administration of the Basic Skills Test. The effect of this limitation is likely a failure to identify some variables that do in fact have an effect on pupil achievement. For example, in this study the set of high-achieving schools did not differ from the set of low-achieving schools in their overall incidence of pupil retention (non-promotion to the next grade) or in the proportion of pupils with kindergarten experience. Using these findings, based on the school as a unit of analysis, one would not infer an association between pupil achievement in math and kindergarten experience or incidence of retention. However, during the course of this investigation and when the Basic Skills Test was administered in 1980, achievement data and information on kindergarten attendance were collected from over 64,000 individual pupils throughout the state, making possible the use of individuals rather than schools as the unit of analysis. These data demonstrated clearly and convincingly that pupils with kindergarten experience had significantly higher scores on all four sub-tests and a

significantly lower incidence of retention in grade than pupils without kindergarten experience. These findings demonstrate abundantly that some variables that indeed exert a positive effect do not always emerge as such when the school is used as the unit of analysis. One must, therefore, resist a temptation to infer that variables that do not distinguish high from low-achieving schools in this study have no influence on the achievement of pupils in math. Indeed, they may. On the other hand, factors that survive the "washing out" effect of variation among classrooms or individuals that can occur when the school is used as the unit of analysis, as was the case in this investigation, probably have a strong association with pupil achievement.

A Need for Cautious Interpretations

The limitations inherent in this study, discussed just previously, are, for reasons already discussed, justifications for cautious interpretations of the findings of this study. There are, however, other reasons for observing caution. One of them has to do with test sensitivity, and one has to do with causality.

A part of a major research effort by Madaus et al (1979) dealt with a study of the sensitivity of various measures of school effectiveness. They found that tests designed to assess information and skills taught in specific courses are more sensitive to differences in school characteristics than are standardized tests. The Basis Skills Test used in Tennessee is not a norm-referenced test of general math ability or achievement. It is a criterion-referenced test designed to assess pupil achievement on a common set of minimum objectives that transcend school district boundaries. The test is not sensitive to measuring a variety of school-specific achievements that

exceed those defined by the statewide minimum objectives. Hence, it is possible that schools classified as high-achieving in math may succeed admirably in developing pupil competencies in the 30 objectives defined as minimum by the state yet fall far short in developing competencies in a broader spectrum of objectives. Likewise, it is possible, though not as probable perhaps, that schools classified as low-achieving may be doing a better job in developing in pupils important competencies that surpass the limited domain of basic skills measured by the test. For these reasons, it is important to resist the temptation to characterize the accomplishments of high-achieving schools as laudatory in all respects or to characterize those of low-achieving schools as lamentable in all regards.

Any association between mathematics achievement and certain school factors that emerge from this research does not, in and of itself, establish a causal relationship between the variables. For example, teachers in the low-achieving schools rated their superintendents as stronger instructional leaders than did teachers in the high-achieving schools. It does not follow, however, that strong instructional leadership is the cause of low achievement in math. It is possible that a recognition of less than desirable achievement in some of the low-achieving schools in the past has led to the emergence of stronger leadership of some superintendents in the present. Or it is possible that superintendents perceived as strong instructional leaders on the part of the teaching staff are emphasizing a broad range of objectives in math or that they are concentrating at the present time on improvements in reading achievement while postponing for a while intensive efforts to deal with the mathematics program. Thus, the determination of cause and effect will require extended research in which selected variables can be

isolated or manipulated under carefully controlled conditions. Hence, many of the findings of this investigation should be regarded as hypotheses to be tested more vigorously than has been possible to date.

Findings of the Study

Numerous variables were studied in this investigation for any association they may have with the mathematics achievement of schools. These variables were classified into seven variable clusters: leadership, curriculum, instruction, school policies and practices, teacher, pupil, and parental/community. Findings were presented under these headings in the body of this report. But because findings from one variable cluster are often related to those from another cluster, this summary of findings is organized differently. Variables on which the two sets of schools differ are presented together, and those on which they did not differ are presented later.

Differences Between High and Low-achieving Schools

The responses of teachers and pupils in the low-achieving schools differed significantly, from a statistical point of view, in several ways from those of their counterparts in the high-achieving schools. In the comparative statements that follow, most of the comparisons are incomplete in order to avoid tiresome repetition. Where a comparative adjective is used to describe the responses of teachers or pupils in one set of schools, it is to be understood that the comparison is always with the responses of teachers or pupils in the other set of schools.

Teachers in low-achieving schools reported that they have been more involved in the planning of the goals, objectives, and the scope and sequence

of local mathematics programs. They claim also a greater prevalence of locally developed curriculum guides that include, but surpass in scope, the 30 basic skills objectives defined by the state and that specify what should be taught and what each child should master at each grade or achievement level. Furthermore, they contend that the basal math textbooks used in their schools are more highly compatible with their local curriculum guides. The teachers in the low-achieving schools also reported having completed a greater number of methods courses in the teaching of mathematics, and they gave their school superintendents higher ratings as instructional leaders than did teachers in high-achieving schools.

The features described above are ones that are commonly associated with excellence in school programs. Yet they are, according to teachers' responses, more characteristic of low-achieving than of high-achieving schools. These phenomena beg for interpretations, and possible interpretations will be discussed after characteristics of high-achieving schools have been more fully explored.

Teachers in low-achieving schools believed more strongly that there seems to be very little that can be done to improve the achievement of children who have persistent problems with learning math. The difference in expressed beliefs of the two sets of teachers was statistically significant. Teachers in the high-achieving schools, on the other hand, tended to a stronger belief, though the difference was not statistically significant, that nearly all pupils who have persistent problems in learning math could learn reasonably well if the school could determine the natures of their problems and devise instructional strategies geared to individual styles of learning. Pupils' responses were consistent with teachers'

responses. Pupils in high-achieving schools reported that their teachers more often offer encouragement to pupils who have difficulty in math and that they more often provide public recognition for pupil successes in math.

These findings do not tell us, of course, that limited expectations or supportive expectations are characteristic of all, or even most, teachers in either set of schools. There was considerable variation in the expression of these beliefs by teachers in both sets of schools. It does mean that teacher attitudes of limited expectations are more prevalent among low-achieving schools than among high-achieving ones. This association between teacher expectations and pupil achievement is consistent with previous research findings. Brookover (1979) found that teachers in schools in which achievement had been improving in recent years tended to believe all pupils can master basic objectives, whereas teachers in schools with declining achievement tended to regard some pupils' abilities as being so low that their mastery of basic objectives would be impossible. Teachers and principals of declining schools felt there was not much they could do to influence the achievement of their pupils. They spent less time in direct instruction, and they tended to place responsibility for skill learning on parents or on the pupils themselves. The displacement of blame, reported by Brookover, appears not to be characteristic, however, of teachers in low-achieving schools in this study. Compared with teachers in high-achieving schools, they gave somewhat higher ratings, although not statistically significant, to parents' encouragement to their children to achieve in math and to their support and reinforcement of teachers' efforts to bring about achievement (Table 31, page 113). They rated just as highly as did teachers in high-achieving schools their pupils' motivation to learn math and their pupils' mastery of prerequisite

skills and concepts needed to master math objectives at their present grade level (Table 25, page 103).

Teachers in low-achieving schools reported that they more often check homework assignments for accuracy. And pupils agreed that teachers in high-achieving schools more often check assignments only for completeness and less often for accuracy. According to pupils, teachers in high-achieving schools more often assign homework, less often allow pupils to do it in class, and more often allow pupils to correct their own homework papers. Teachers in the two sets of schools, with one exception to be noted shortly, do not differ in the amount of class time they claim they permit pupils to use to complete homework assignments or on the amount of time they expect pupils to spend on homework outside of class. The one exception occurred between the two groups of primary teachers (grades 1-3). Those in high-achieving schools reported that they allow significantly more time for their pupils to work on homework assignments during class. This difference did not hold for teachers of grades above grade three.

Teachers in high-achieving schools believe their schools do a better job in challenging fast-learning, highly able pupils. However, in responding to another questionnaire item having to do with the prevalence of well-planned and successful accelerated or enrichment math programs for these pupils, teachers in the two sets of schools did not differ. In fact, both sets of teachers rated such programs as "prevalent to a very small extent." From the differences in teachers' responses to these two items, one may infer that teachers in high-achieving schools believe more strongly that, in the absence of operational programs for highly capable pupils, they are personally rather than programmatically challenging these pupils more than

are teachers in low-achieving schools.

Teachers in the high-achieving schools claim they use a greater variety of instructional materials in the first three grades than do teachers in low-achieving schools. But teachers of all grades in the two sets of schools did not differ at all in rating the variety and quantity of supplementary materials that are available to them. Both sets of teachers rated the quantity and variety of available supplementary materials as only slightly more than "prevalent to a very small extent." If such materials are supplied to a limited extent, available equally in both sets of schools, and if teachers of the primary grades in the high-achieving schools use a greater variety of instructional materials than their counterparts in low-achieving schools, then one is led to believe that primary grade teachers in the high-achieving schools are either more resourceful or that they spend more time and effort in preparing such materials.

Teachers of grades seven and eight in high-achieving schools report that they give primary emphasis to the mastery of minimum basic skills, as defined by the state, and significantly less emphasis to a broad range of other objectives. These teachers stress minimum basic skills in grades seven and eight to to a significantly greater extent than do teachers of the same grades in low-achieving schools. Moreover, they claim to stress basic skills in grades seven and eight to a greater extent than do teachers of any of the lower grade levels in the same high-achieving schools. Among the low-achieving schools, the greatest emphasis on basic skills was reported by teachers of grades four through six. Seventh and eighth grade teachers in the low-achieving schools place as much emphasis on a broad range of objectives as they do on the 30 minimum objectives.

Certain anecdotal information reported by field observers is consistent with teacher reactions, just reported, to questionnaire items. In 11 of the 13 high-achieving schools, eighth grade teachers, in one way or another, make special efforts to prepare pupils for the Basic Skills Test, according to field observers who interviewed the teachers. The following statements are typical of their observations and interviews in high-achieving schools:

> Eighth grade classes reviewed the test given the previous year and stressed K-6 objectives for several weeks before the 1980 test was administered.
>
> Eighth grade teachers in (name confidential) school teach specifically for all thirty objectives.
>
> A unit on each of the thirty objectives is taught during the seventh and eighth year of mathematics.

On the other hand, only about three of the 13 low-achieving schools appear to make a concerted effort to teach the 30 basic skills specifically. The comments below are representative of field observers' comments about seventh and eighth grade math programs in low-achieving schools.

> The school principal expects basic skills to be reinforced in grades seven and eight, but he also expects teachers to stress new learnings beyond basic skills in the upper grades.
>
> Not much stress is given to basic skills beyond the sixth grade.
>
> Emphasis in the seventh and eighth grade is on concepts, such as ratios, proportion, equalities, powers, and roots, to get pupils ready for high school algebra.

As noted previously, teachers in low-achieving schools reported a greater prevalence of locally developed curriculum guides, that they have been more personally involved in the identification of goals and objectives, more involved in selecting the content, and more involved in planning the

the scope and sequence of the math program than have teachers in high-achieving schools. Teachers in the low-achieving schools also have completed a significantly greater number of courses in methods of teaching mathematics. These differences, when considered collectively, give rise to an hypothesis that teachers in low-achieving schools feel a sense of ownership of the local curriculum guide, believe the appropriate role of the upper two grades is to emphasize a broad range of objectives while reinforcing and maintaining basic skills, and are less willing to compromise what they consider to be the integrity of their math programs in spite of public pressures for accountability for achievement in 30 basic skills, which they believe should have been mastered for the most part by the end of grade six. The findings also suggest an hypothesis that many eighth grade teachers in high-achieving schools have responded to the pressures of accountability by devoting a considerable portion of the year to teaching the 30 minimum objectives to pupils who already have a good mastery of basic skills as well as to those who do not and to providing the drill and repetition that results in higher test scores among their pupils than is the case for pupils in low-achieving schools. This hypothesis is supported by the fact that the math scores of high-achieving schools were significantly higher than their scores in reading or in language. Because of the specificity of math objectives and the clarity of mathematical operations, it is undoubtedly easier and more successful to raise math scores by direct and concerted instruction in the eighth grade than it is to raise language or reading scores by the same kind of efforts.

Recall that math scores of low-achieving schools were significantly lower than their scores in language or reading. The daily use of language and reading surely helps to maintain skills in these subject areas to some

extent. But specific mathematical skills, even if previously mastered, may be more easily forgotten if not reinforced or used frequently over a period of several months. Since most low-achieving schools did not stress basic skills in math specifically in the eighth grade, it is possible that a difference between the retention of math skills and the retention of skills in reading and in language may account for their lower scores in math than in reading or language.

Although the two sets of schools did not differ in their overall incidence of requiring pupils to repeat a grade for reasons of poor academic achievement, they did differ in certain retention patterns. Of the pupils (grades 5-8) who have been retained in the schools studied, the high-achieving schools retained a significantly larger portion in the first two grades and a significantly lower portion in the last three grades. The schools did not differ in retention practices in grades three, four, or five. These findings suggest that schools that decide on not promoting borderline cases in the early grades may reduce the need to retain those pupils in the later years. Conversely, the promotion of borderline cases in the early grades may increase the need to retain those pupils in the upper grades.

Variables on Which the Two Sets of Schools Did Not Differ

Data from this study indicate that the two sets of schools do not differ significantly from each other in a variety of ways. As noted previously, a null difference does not demonstrate that a certain variable has no effect on achievement in mathematics. It is possible that a given factor may influence math achievement in both sets of schools to about the same extent and in the same direction. A null difference means only that a specified factor is not differentially operative to a sufficient extent to

account for differences in the mean scores of high and low-achieving schools. Since the similarities between the two sets of schools do not explain differences in their mean achievement scores and thus require no discussion, they are simply enumerated below.

Teachers in the two sets of schools did not differ in their ratings of:

(a) principals' willingness to help find a source of assistance when teachers encounter problems in teaching math.

(b) the importance attached by principals to the achievement of each and every child in mathematics.

(c) the worth of past in-service programs in helping teachers improve the instructional programs in math.

(d) the effectiveness of math textbooks and other teaching materials in providing for continuity and a well-integrated instructional program from grade level to grade level.

(e) their schools' success in avoiding gaps and unnecessary repetition in the math program.

(f) the extent to which teachers adhere to the content and instructional sequence of the math textbook.

(g) the extent to which teachers personally plan the instructional program in relation to pupil achievement and local objectives for mathematics instruction.

(h) the adequacy of their schools' math programs in providing for the learning needs of slow-learning or low-achieving pupils.

(i) the effectiveness of their schools' programs for the systematic diagnosis of pupil learning difficulties.

(j) the adequacy of provisions for remedial instruction beyond what can be accomplished by the regular classroom teacher.

(k) pupil motivation to learn mathematics.

(l) the quality of their schools' math programs in relation to community expectations.

(m) parental encouragement, support, and reinforcement of schools' efforts to bring about achievement in mathematics.

(n) their pupils' previous mastery of particular math concepts and skills needed to achieve the objectives of their present grade level.

(o) teachers' interest in teaching math or their perceived difficulty with teaching math. (Both groups reported a fairly strong interest in teaching math; neither group felt that math is especially difficult to teach.)

The two sets of schools did not differ with respect to:

(a) the appropriateness of teacher certification status for present teaching assignments.

(b) the number of credits earned in college math by the teachers. (Teachers in high-achieving schools completed slightly more college credits, but the advantage was not statistically significant.)

(c) the number of high school math courses completed by teachers. (Again, teachers in high-achieving schools held a small advantage, but it

was not statistically significant.)

(d) the extent to which teachers reported that they organize instruction for small groups or individuals, based on achievement levels within the class, or in the extent to which they provide different homework assignments for different individuals or small groups.

(e) teachers' reports of the prevalence of firm arrangements and regular discussions between teachers at different grade levels (and between schools, where appropriate) to avoid gaps and unnecessary repetition in the math program.

(f) teachers' reports of schools' efforts to discourage unnecessary absence of pupils.

(g) the actual incidence of pupil absence from school, according to data supplied by school attendance officers.

(h) the amount of time allocated for math instruction. (No information was available about how effectively or efficiently the time is used, how much time is devoted to time-on-task, how much is spent on organization, management, or various other kinds of non-productive time.)

(i) the average size of math classes.

(j) the type of school organization (self-contained classes, departmentalization, other).

(k) the proportion of pupils who attended either nursery school (or Head Start) or kindergarten. (See a discussion on this matter on page 120.)

Pupils in the two sets of schools did not differ in their ratings of:

(a) the extent to which teachers assign extra math problems to pupils who misbehave.

(b) the extent to which teachers allow pupils to exchange papers and correct each others' homework.

(c) the extent to which teachers allow sufficient wait-time after asking a question and before referring the question to someone else.

(d) the extent to which teachers ask questions that require pupils to think about how to solve problems.

(e) their teachers' relative emphasis on how to solve problems as opposed to getting "the right answer."

(f) the teachers' emphasis on helping pupils understand how math is needed and used in everyday life.

(g) how much their teachers enjoy teaching math.

(h) how well teachers ensure that pupils receive help when they have trouble with math.

(i) how well their teachers like their pupils.

(j) their own motivation to learn math and earn good grades in it.

(k) the attitudes of their peers toward pupils who do well in math.

(l) their own interest in math as a school subject.

(m) any of several statements having to do with parental expectations

or interest in pupil achievement in math.

(n) several statements having to do with parents' ability and willingness to provide help with math homework if needed.

Some Common Characteristics of Special Interest

Although similarities between the two sets of schools do not account for differences in the schools' mean scores, the nature or direction of certain similarities offer some insight into the status of conditions or practices in Tennessee schools. Those that are of special interest to this investigator are discussed below.

(a) Teachers in both sets of schools reported that their school principals stress greater attention to the mastery of minimum basic skills than to a broad range of objectives that extend beyond the 30 basic skills objectives defined by the state.

(b) Teachers in both sets of schools reported a greater prevalence of personal instructional planning and use of teaching materials based on pupil needs and local objectives than of strict adherence to the content and instructional sequence of the adopted mathematics textbook.

(c) Teachers in both sets of schools agreed on the relative emphasis that is given to conceptual learning compared with the development of computational skills. Teachers in both sets generally believed that their math programs strike a desirable balance in the emphasis given to conceptual learnings and to computational skills, with the balance tilting slightly (but not significantly) toward computational skills over conceptual development.

(d) Teachers in both sets of schools generally agreed that their math programs strike a desirable balance between "modern math" and "traditional math." Their conception of a desirable balance, however, is one that stresses "traditional math" to a significantly greater extent than "modern math."

(e) Teachers in the two sets of schools did not differ in their evaluation of their schools' accelerated or enrichment programs for fast-learning, highly capable pupils. In both sets of schools, teachers reported that well-planned and successful programs are "prevalent to only a very small extent."

(f) Both groups of teachers rated in-service programs as valuable only "to a very small extent" in helping them improve the instructional program in mathematics.

(g) A significantly greater number of pupils in both sets of schools rated math as their most favorite subject than rated it as their least favorite subject.

(h) Pupils in both sets of schools rated their parents' interest in their math achievement quite strongly. On a scale from one to five, the mean ratings to two statements by the two groups of pupils ranged from 4.4 to 4.6.

(i) Teachers in both sets of schools expressed a fairly strong interest in the teaching of mathematics. By no means is mathematics among their least favorite subjects to teach.

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APPENDIX A

GUIDELINES FOR FIELD STAFF

for School Visits to Collect Data
on School Variables Influencing 8th Grade Achievement Scores

March, 1980

Preparing for the School Visit

Contact the Superintendent. The cooperation of schools has been requested in a letter from the Commissioner of Education to superintendents of schools. Before contacting school principals, it would be a good idea to contact the local superintendent of schools not only as a matter of courtesy but to ascertain discreetly whether the superintendent has communicated the Commissioner's request to the appropriate principal(s). If the principal has not been informed, give the superintendent sufficient time to do so before contacting the principal. In such case, you might ask the superintendent to suggest an appropriate time for you to make the initial contact with the principal.

Contact the Principal(s). Arrange with the principal(s) a day for meeting with the faculty and for collecting data that is convenient for the school and that also can be fitted into your schedule. Data collection in a single school can be accomplished in one day unless a meeting with the faculty can be scheduled only after school hours, in which case it will be necessary to return on the following day to administer or to collect questionnaires. In cases where a single field staff person is collecting data from a junior high school (with only 2 to 4 teachers of math) and one feeder school, it may be possible, depending on local circumstances, to devise a schedule that permits collection of data from both schools in a single day.

In planning with the principal for your visit, make sure that arrangements are adequate to accomplish the following things: (1) meet briefly with the faculty, (2) administer questionnaires to teachers in grades K-8, (3) have teachers administer questionnaires to pupils in grades five through eight, and (4) personally collect information requested on the Field Observer's Questionnaire. Be sure to read the rest of these guidelines for specific requirements and suggestions before completing arrangements with the principal(s).

When to Visit Schools. Make arrangements for your school visit as soon as possible after the orientation meeting. If at all possible, schedule your visit before the first of April. Our objective is to complete these school visits at least two weeks before school programs are again interrupted by eighth grade testing, local testing, and the numerous other activities that begin a month to six weeks before the end of the school year. If, however, local officials prefer a date in early April over the last two weeks in

March, then by all means honor their preference if your schedule permits.

Report Visitation Schedule. When a date for the school visit has been arranged, please use the brief memo provided in the orientation meeting to inform the Division of Research and Development of your school visit schedule. (In cases where two or more field staff persons from the same district office are visiting several schools in the same school system, one form may be used to report the schedule of all of them.) We need to keep track of a fairly massive research effort throughout the state. Also, if unusual and unexpected circumstances, such as extended illness, prevent your visiting schools within the prescribed time, please try to inform us so that we can work out other arrangements for collecting data.

Record School Numbers. Before visiting the school, please write in ink the school number on the front cover of each teacher questionnaire and also on the front page (lower center) of the instructions for ADMINISTRATION OF PUPIL QUESTIONNAIRES, which are to be given to teachers. These four-digit numbers (beginning with either 1 or 2) are included on the sheet entitled, "Number of Teachers and Pupils in Main Study," and distributed at the orientation meeting; they are not the school identifying numbers listed in the state directory.

Request teachers to write this same identifying number in large numerals on the chalkboard and have each pupil record this number on the front page of his or her questionnaire. It is essential in the analysis of data that the school identification number appear on each and every questionnaire and that all questionnaires, both teacher and pupil, returned from a given school bear the same identifying number.

Meeting with Teachers

Who Should Attend? The initial effort of your school visit should be a meeting with the teaching staff to discuss with them the nature of the research effort and their role in its success. The meeting should include the school's administrator(s), if possible, and all teachers who teach mathematics in a regular classroom setting. Questionnaires should not be completed by Title I math teachers, special education teachers, librarians, reading or speech specialists, substitute teachers, or by any other person who does not teach mathematics as part of the "regular" curriculum on a sustained basis. Persons who will not complete the teacher questionnaire should, of course, be invited to attend the meeting, but it should be pointed out that their attendance is optional unless the school principal requires it.

Purposes of the Meeting. The purposes of the meeting can probably be accomplished in twenty minutes or less. They are:

(1) to review the purposes of the research,

(2) to explain how schools were selected,

(3) to emphasize the role that school data will play in the overall statewide research effort to improve achievement; de-emphasize any notion that the school has been singled out as a target of special investigation.

Data from a single school or from a single school system will not be analyzed or reported. Instead, data from each eighth grade school, and its feeder schools, will be pooled with that of more than a dozen other eighth grade schools, along with their feeder schools. All questionnaires will be unidentifiable except by school; neither research data nor achievement scores from a school will be associated with the name of the school in the report of research findings.

(4) discuss arrangements for and answer questions pertinent to the administration of pupil questionnaires. (Distribute to each teacher, as nearly as possible, the exact number of pupil questionnaires needed by that teacher, along with one copy of instructions for ADMINISTRATION OF PUPIL QUESTIONNAIRES on which you have already recorded school number.

(5) discuss arrangements for and answer questions pertinent to the completion of teacher questionnaires.

Completing the Teacher Questionnaires

Under ideal circumstances, the teacher questionnaires should be distributed, completed, and collected while the teachers are assembled as a group. But ideal circumstances occur only rarely. In their absence, the field staff person must work out arrangements with the school principal for teachers to complete the questionnaires. Based on results from the pilot study in the late Fall of 1979, we estimate that teachers will need about 30 minutes to complete the questionnaire. (Compared with the present questionnaire requiring 65 responses, the pilot study required 146 responses and teachers generally completed it in one hour or less.) Possible arrangements include completing the questionnaires during:

(1) a group meeting of teachers before or after school,

(2) teachers' unscheduled time with pupils in some departmentalized schools,

(3) during class time when a relief person supervises the class during the teacher's absence. (In one pilot study school, the principal and district supervisor relieved teachers on a rotating basis throughout the day.)

It is highly desirable that teachers react to the questionnaires independently. If at all possible, avoid arrangements that permit teachers to discuss reactions among themselves before turning in their questionnaires. If questionnaires are taken home overnight, you may have much difficulty in getting them all returned the following day. Since different circumstances prevail at different schools, it will be necessary for each field staff person to work out arrangements with the school using the underlined statements above as guidelines.

Encourage Complete Responses. Encourage teachers to react to every questionnaire item! If they are hesitant about responding, they can circle

"1" for do not know if it is prevalent in THE MATHEMATICS PROGRAM; they can circle (3) for uncertain in the section AGREE OR DISAGREE?; and they can circle "1" for not applicable in the section HOW OFTEN? It is far preferable that they respond to each item, using these choices if necessary, than to not respond at all.

Administering Pupil Questionnaires

Before meeting with teachers, read carefully the teachers instructions for ADMINISTRATION OF PUPIL QUESTIONNAIRES. Emphasize at the meeting with teachers any of the instructions that you feel should be brought to their attention, remembering that they may not have much time to read the instructions carefully and thoughtfully before administering the questionnaires to pupils.

Pupil questionnaires may be administered by teachers during math class. Based on experience in the pilot study, we estimate that most classes can complete the questionnaire within 30 minutes. If a teacher has a pupil who is handicapped to such an extent that the teacher believes the pupil can not comprehend the questionnaire sufficiently to respond reasonably intelligently, tell the teacher to collect questionnaires in such a way that that pupil's questionnaire can be identified and discarded. (See item E, pp. 1-2 of ADMINISTRATION OF PUPIL QUESTIONNAIRES for suggestions for discarding questionnaires from another type of pupil.)

Some pupils may be reluctant to respond candidly if their responses are being observed. (Some questionnaire items deal with pupil perceptions of teacher behaviors and teaching practices.) Ask teachers to station themselves or to move about the room, while administering the questionnaires, in such a way that pupils' responses to individual items on the questionnaire are out of the range of acute vision. In other words, pupils should be assured by word and by deeds that their responses are confidential and anonymous.

Returning the Questionnaire

Because the department's data processing center will be inoperative during much of May due to installation of new equipment, it would be desirable for questionnaires to be returned soon after your visit so that data processing can be completed by the end of April.

Questionnaires collected by all field staff persons from a district office may be returned together if you like. Please consider the following alternatives in getting questionnaires back to us expeditiously:

(1) Bring or send them via automobile when someone from your district office makes a trip to "Fort Fumble." If this should result in much delay, please mail teacher questionnaires promptly in large envelopes and send pupil questionnaires later by courier.

(2) Box all questionnaires and ship by United Parcel. Ship to:

Dr. Bobby J. Woodruff
Division of Research and Development
Tennessee State Department of Education
Cordell Hull Building, Room 142
Nashville, TN 37219

(3) Send an S. O. S. to 615-741-7816 for advice if all else fails.

CHECK LIST

_____ Superintendent contacted prior to contact with school principal

_____ Principal contacted

_____ Date set for school visit when all objectives can be accomplished

_____ Research and Development notified of date(s) of visit(s)

_____ School numbers recorded on teacher questionnaires prior to visit

_____ School numbers recorded on ADMINISTRATION OF PUPIL QUESTIONNAIRES prior to visit

_____ Meeting with teaching staff

_____ All questionnaires collected from teachers and pupils who were asked to complete questionnaires

_____ All questionnaires returned to Division of Research and Development, Cordell Hull Building, Nashville, TN.

APPENDIX B

ADMINISTRATION OF PUPIL QUESTIONNAIRE

Planning for Time

The questionnaire may be administered at a time that is most convenient in the daily schedule. The total time for administering the questionnaire probably should not exceed thirty minutes. Since many items have to do with pupils' feelings and attutudes, the questionnaire should be administered when the classroom atmosphere is typical. If possible, avoid having pupils complete the questionnaire at a time when their feelings or attitudes may be temporarily distorted, such as following the return of graded test papers, after an exciting school assembly, or when the class may be tense as a result of a disciplinary problem.

General Instructions

A. Insist that pupils use pencils (no ink) and have clean erasers available. All changes in responses must be done by erasing completely and re-entering the desired response. Do not allow "crossing out" of responses as a means of alteration.

B. Remind pupils NOT to write their names or the name of their teacher anywhere on the questionnaires. Questionnaires are to be submitted anonymously except for a number that identifies the school.

C. Have each pupil write the school number on the line provided at the top-center of the cover page of the questionnaire. Write the following number on the chalkboard in large-size numerals for pupils to copy.

School Number: _____

D. A few questionnaire items refer to parents. Inform your pupils before they begin the questionnaire that the word parent(s). for purposes of this questionnaire, refers to any adult(s) with whom the child lives and who is primarily responsible for the time being for the welfare of the child. Such adult(s) may be a natural parent, a foster parent, another relative, or even a family friend or neighbor with whom the child lives and to whom the child is responsible.

E. Most pupils will be cooperative and will respond responsibly by answering items in a way that reflects their sincere feelings and attitudes.

Occasionally, however, despite pleas of cooperation, a child will persist in taking a questionnaire lightly and will play games with the responses, answering in ways that do not express true feelings or attitudes. If, after your efforts to get pupils in a responsible, constructive frame of mind for completing the questionnaire, there is evidence to suggest that a pupil is responding otherwise, let the matter pass in a way that is least disturbing to other pupils. Then, when you collect the completed questionnaires, put that pupil's questionnaire on the top or bottom of the stack so that you can later identify it and discard it. It is preferable to discard such questionnaires than to allow insincere or inaccurate responses to contaminate data collected from the rest of the class.

Front Page

Remind pupils at the outset not to turn the page and begin reading or responding to items on page two until they are instructed to do so.

For the first four items on the front page, please read each statement aloud and have pupils respond to it before reading and responding to the next item.

Item #1. Make sure that every pupil circles one, and only one, of the numerals to show the grade they are in this year. The questionnaire is to be administered only to pupils who are in grades 5 through 8 in 1979-80.

Item #2. You may need to help some pupils interpret what constitutes nursery school so far as the intent of the questionnaire is concerned. We are interested in nursery school experience that emphasizes cognitive, social, and emotional growth and is staffed by, or is at least under the direction of, a professionally trained person. A day care center or other arrangement that is essentially custodial and not primarily concerned with child growth and development is not to be considered, for present purposes, as nursery school experience.

Item #3. Ask pupils to circle "Yes" for kindergarten attendance only if they were in kindergarten for most of the school year. If a child were in kindergarten for only a few weeks, or even two or three months, he should circle "No."

Item #4. Each child should circle "Yes" or "No" to indicate whether he or she has ever repeated a grade--failed a grade, held back, or was not promoted. You may need to use several synonyms so that everyone clearly understands the meaning of the statement. Pupils who circle "No" have nothing more to do on the front cover. Pupils who circle "Yes" should place a check mark in front of each numeral that shows a grade they have repeated. There should be as many checks as the number of grades a pupil has repeated.

When pupils have completed the four items on the first page, tell them to turn to page two.

MY MATH CLASS

Ask pupils to read the directions silently while you read them aloud. Remind them not to begin responding to any items until you have gone over the sample items together.

Read sample statement (a). Response #5 is already circled to show the mode of response, based on the assumption that all pupils will "agree A LOT." If any pupil prefers a response other than #5, ask him to circle the response of his choice. Do the same for sample statement (b). Read the other sample statements aloud, allowing time after each reading for pupils to circle the response of their choice. Do not allow pupils to begin responding to item #5 and beyond until you are sure that they understand how to do the sample items. Remind them that there are no right or wrong answers. How they mark each statement depends only on how much they agree or disagree with the statement.

When it is clear that pupils understand how to respond to express agreement or disagreement with a statement, tell them to begin with item #5 and go right on to the end of the questionnaire (item #46), reading each statement silently and responding to it to indicate agreement or disagreement. Remind them once again to circle only one numeral for each statement and to erase completely, not "cross out," any circle they wish to change. Encourage them to respond to every item. If a pupil can not make up his mind on a given statement, a suitable choice is "3 - I am not sure."

When everyone has completed all 46 items, ask them to look back over the questionnaire to make sure that each item has been answered, that there are not two responses to any item, and that there are no "cross outs" for changed responses.

If a pupil asks for assistance in interpreting a word or statement, you may offer assistance if you wish to do so. The questionnaire is not an achievement test. Since the object is to find out the extent to which pupils agree with statements, there is no objection to helping them understand meanings of words or statements if it can be done in a way that does not influence the pupils' agreement or disagreement with statements.

APPENDIX C

FIELD OBSERVER'S QUESTIONNAIRE

Field Observer: _____ School Number _____

1. Does the school or school system have special, transitional type classes designed to correct achievement shortcomings in math without the necessity for a pupil to repeat an entire year? If so, for what grade levels?

2. Does the school or school system offer a remedial math program in the summer for pupils up to grade eight?

3. Have the faculty or conditions in the school been unstable during the past eight years? If so, how? (Consider factors such as unusual shifts in pupil population or faculty due to re-zoning, dispersals due to burned buildings, massive consolidation, de-regionalization, busing, and the like.) Use reverse side if needed.

4. How many different principals has the school had during the past eight years? If more than one, is there evidence that such changes resulted in marked shifts in curriculum emphasis, discipline climate, instructional practices, teacher morale, or other factors that might have influenced pupil achievement one way or another? Use reverse side if needed.

5. Has there been a concerted or intensive effort to prepare eighth grade pupils specifically for taking the Basic Skills Test either in 1978-79 or in 1979-80?

6. (a) Does the school or school system have a written promotion policy? Is it enforced uniformly? In the absence of such a policy, are there traditional practices that, in effect, constitute a policy?

   (b) What factors are considered in deciding on promotion or retention? (Achievement in certain subjects, social-psychological factors?)

   (c) Who is involved in making decisions regarding promotion and retention? (Is promotion a matter solely of teacher judgment? Role of school principal? Are parents consulted; is their consent required?)

7. Are teacher aides or paraprofessionals used in math classes? If so, to what extent and in what grades are they used?

8. Does the time of day when math is taught vary from class to class? If the time when math is taught is generally uniform among classes, is math taught in the early morning, late morning, early afternoon, or near the end of the day?

9. (a) What basal materials were used for teaching math in grades 1 and 2 in 1971-73?

   (b) What basal textbooks were used in math in grades 3-6 in 1973-77?

   (c) What basal textbooks were used in math in grades 7-8 in 1977-79?

APPENDIX D

Teacher Questionnaire -- Yellow Pages

APPENDIX E

Pupil Questionnaire -- Blue Pages

ED-2308

APPROVED FORM
DS-PE-008
E. A. COX, Commissioner

TEACHER QUESTIONNAIRE

School Number: _____

THE MATHEMATICS PROGRAM

Listed below are a number of statements that describe a practice or condition that may exist in your classroom, your school, or your school system. Some of the practices or conditions described you may consider to be desirable; others you may consider undesirable.

Indicate by circling the appropriate numeral in the right margin the extent to which the statement represents a condition or practice prevalent in your school, using the following code:

1 - not at all prevalent; or, do not know if it is
2 - prevalent to a very small extent
3 - moderately prevalent
4 - considerably prevalent
5 - strongly or outstandingly prevalent

Statements	Degree of Prevalence				
1. My school system uses a locally developed curriculum guide that includes but surpasses in scope the objectives for mathematics instruction outlined in Tennessee's Student Expectations in the Basic Skills, K-6 (minimum skills).	1	2	3	4	5
2. The curriculum guide developed for use in my school (system) identifies objectives that specify what should be taught and what each child should master at each grade or achievement level up through grade eight.	1	2	3	4	5
3. Classroom teachers are (or have been) involved in planning the goals, objectives, content, and scope and sequence of the local mathematics program.	1	2	3	4	5
4. The basal mathematics textbooks used in my school are highly compatible with the local curriculum guide. (Check #1 if there is no local curriculum guide.)	1	2	3	4	5
5. Textbooks and other teaching materials in primary use in our mathematics program provide for continuity and a well-integrated instructional program from grade level to grade level.	1	2	3	4	5

Statements	Degree of Prevalence				
6. In my school, there are firm arrangements and regular discussions between teachers at different grade levels (and between schools, if appropriate) to avoid gaps and unnecessary repetition in the mathematics program.	1	2	3	4	5
7. In the local school(s), we are successful in avoiding gaps and unnecessary repetition in the mathematics program.	1	2	3	4	5
8. My school has a well-planned and successful accelerated or enrichment math program for fast-learning, highly able pupils.	1	2	3	4	5
9. Pupils who are not in a special education program are not generally promoted from one grade to another unless their achievement in mathematics is at, or very near, grade level.	1	2	3	4	5
10. The principal of my school is willing to help find a source of assistance for teachers to solve whatever problems they encounter in the teaching of mathematics.	1	2	3	4	5
11. The principal of my school makes it clear that he/she attaches considerable importance to the achievement of each and every child in mathematics.	1	2	3	4	5
12. The principal of my school stresses attention to a broad range of objectives in mathematics that extend well beyond the minimum basic skill objectives defined by the state.	1	2	3	4	5
13. The principal of my school impresses upon teachers at all grade levels the need to devote the fullest effort that is necessary for pupils to master minimum basic skills in math, as defined by the state, even at the expense of broader objectives.	1	2	3	4	5
14. The superintendent of schools in my system is a strong instructional leader.	1	2	3	4	5
15. In-service programs are designed and carried out that provide the amount and kind of help that teachers really need in order to improve the instructional program in mathematics.	1	2	3	4	5
16. Supplementary materials for teaching math (such as games, puzzles, worksheets, and other non-textbook devices) are available in adequate quantities.	1	2	3	4	5
17. Supplementary materials for teaching mathematics are available in a variety that is appropriate for the range of achievement levels of pupils in my classroom.	1	2	3	4	5
18. My instructional program in mathematics adheres strictly to the content and instructional sequence of the adopted textbook.	1	2	3	4	5

Statements	Degree of Prevalence				
19. Based on my assessment of pupil achievement and the local objectives for math instruction, I am permitted to, and do, select the content and plan the instructional sequence of the year's program, then use the textbook and supplementary materials in ways that best fit those plans.	1	2	3	4	5
20. I place primary emphasis on the minimum basic skills in mathematics, as defined by the state, and place secondary emphasis on other objectives of mathematics instruction.	1	2	3	4	5
21. I emphasize a broad range of objectives that are important in the growth and development of children, of which the minimum basic skills are a small, although important, part.	1	2	3	4	5
22. My school's math program stresses the practice and repetition needed for pupils to master the minimum basic skills, as defined by the state.	1	2	3	4	5
23. My school's math program challenges fast-learning pupils.	1	2	3	4	5
24. My school's math program adequately provides for the learning needs of slow-learning or low-achieving pupils.	1	2	3	4	5
25. My school has an effective program for the systematic diagnosis of pupil learning difficulties.	1	2	3	4	5
26. My school provides adequately for remedial instruction beyond what can be accomplished by the regular classroom teacher.	1	2	3	4	5

AGREE OR DISAGREE?

Below are several statements regarding your attitudes, viewpoints, beliefs, and practices and conditions within your school. To the right of each statement, indicate the degree to which you agree or disagree with the statement by circling numerals according to the following code:

1 - Strongly Disagree (SD)
2 - Disagree (D)
3 - Uncertain (U)
4 - Agree (A)
5 - Strongly Agree (SA)

Statements	SD	D	U	A	SA
27. Math is one of the *most interesting* school subjects for me to teach.	1	2	3	4	5
28. Math is one of the *least interesting* school subjects for me to teach.	1	2	3	4	5
29. Math is one of the *most difficult* school subjects for me to teach.	1	2	3	4	5
30. Math is one of the *least difficult* school subjects for me to teach.	1	2	3	4	5
31. There seems to be very little that can be done to improve the achievement of children who have persistent problems with learning mathematics.	1	2	3	4	5
32. I am confident that nearly all of my pupils who have persistent problems in learning mathematics could learn reasonably well if the school could determine the natures of their problems and devise instructional strategies geared to their individual styles of learning.	1	2	3	4	5
33. Our school's program in mathematics is just as good as parents and the community expect it to be.	1	2	3	4	5
34. Most of my pupils are sufficiently motivated to learn mathematics.	1	2	3	4	5
35. Most parents encourage their children in my class(es) to achieve in mathematics, and they support and reinforce my efforts to bring about pupil achievement.	1	2	3	4	5
36. Our math program stresses conceptual learnings in math at the expense of computational skills.	1	2	3	4	5
37. Our math program stresses computational skills at the expense of conceptual learnings.	1	2	3	4	5
38. Our math program strikes a desirable balance between stressing conceptual learnings and computational skills.	1	2	3	4	5

Statements	SD	D	U	A	SA
39. Our math program stresses "modern math" over "traditional math."	1	2	3	4	5
40. Our math program stresses "traditional math" over "modern math."	1	2	3	4	5
41. Our math program strikes a desirable balance between "modern math" and "traditional math."	1	2	3	4	5
42. My school has a successful remedial program in mathematics.	1	2	3	4	5
43. Although a brief review may be in order, nearly all of my pupils began the year with a mastery of the particular mathematical concepts and skills needed to master the objectives for their present grade level.	1	2	3	4	5
44. My school makes a concerted effort to discourage unnecessary absence of pupils and communicates that position to parents.	1	2	3	4	5

HOW OFTEN?

Below are several statements regarding certain teaching practices. To the right of each statement, indicate how often the practice occurs in your classroom by circling numerals according to the following code:

1 - not applicable for the grade(es) I teach (NA)
2 - almost never (AN)
3 - occasionally (O)
4 - frequently (F)
5 - almost always (AA)

Statements	NA	AN	O	F	AA
45. The same homework assignment in math is given to the entire class.	1	2	3	4	5
46. Different individuals and/or small groups are given different assignments in math based on different achievement levels.	1	2	3	4	5
47. The same instructional materials are used by all pupils, even if they do not all use the same materials at the same time.	1	2	3	4	5
48. Math homework assignments are checked thoroughly by the teacher (or aide) for accuracy of solutions.	1	2	3	4	5
49. Math homework assignments are checked quickly by the teacher (or aide) for completeness rather than for accuracy of solutions.	1	2	3	4	5
50. Pupils in my class exchange papers and correct each others' math homework as we go over the assignment in class.	1	2	3	4	5
51. Pupils in my class correct their own math homework as we go over the assignment in class.	1	2	3	4	5
52. I organize and plan mathematics instruction for my class as a whole rather than for different small groups or individuals within the class. (Teachers with split grades, consider one grade level as a whole class.)	1	2	3	4	5
53. I plan mathematics instruction for small groups or individuals, organized on the basis of achievement levels, rather than for the class as a whole. (Teachers with split grades, consider a grade level as a whole class.)	1	2	3	4	5

INFORMATION

For the remainder of the questionnaire, place a check (✓) in the blank to the left of a response that indicates your answer to a question. Check more than one response where appropriate.

54. In what grade level(s) do you teach mathematics this year?

___K ___1 ___2 ___3 ___4 ___5 ___6 ___7 ___8

55. What type(s) of Tennessee certification do you now hold?

_____ Professional elementary, grades K-3 only
_____ Professional elementary, grades 1-8(9)
_____ Professional secondary with mathematics endorsement
_____ Professional secondary without mathematics endorsement
_____ Permit
_____ Interim
_____ Other

1	2

Do not write in box above.

56. Including this year, how many years have you taught mathematics as a part (or all) of your teaching assignment in this school?

(1) _____ 0-2 years (3) _____ 4-6 years (5) _____ 8-10 years
(2) _____ 3-4 years (4) _____ 7-8 years (6) _____ more than 10 years

57. How many quarter or semester courses have you completed in methods of teaching arithmetic/mathematics?

(1) _____ one (2) _____ two (3) _____ three (4) _____NONE

58. How many quarter hours of college mathematics, excluding methods courses, have you completed? (Multiply number of semester hours by 1.5; 3 sem. hr. = 4.5 qtr. hr.)

(1) ___ 1-6 qtr. hr. (3) ___ 13-18 qtr. hr. (5) ___ NONE
(2) ___ 7-12 qtr. hr. (4) ___ more than 18 qtr. hr.

59. How many years of mathematics did you complete in high school?

(1) ___ one (2) ___ two (3) ___ three (4) ___ four or more (5) ___NONE

60. On the average, how many minutes on a typical day does a pupil in your class receive instruction in mathematics, including any time spent in class working on a homework assignment?

(1) ____ 0-10 min.
(2) ____ 11-20 min.
(3) ____ 21-30 min.
(4) ____ 31-40 min.
(5) ____ 41-50 min.
(6) ____ 51-60 min.

61. How many minutes are available to a pupil for working on math homework during math class on a typical day?

(1) ____ none
(2) ____ 1-5 min.
(3) ____ 6-10 min.
(4) ____ 11-15 min.
(5) ____ 16-20 min.
(6) ____ 21-25 min.
(7) ____ 26-30 min.
(8) ____ 31-35 min.
(9) ____ 36-40 min.

62. How many minutes a day do you expect a typical pupil to spend doing math homework outside of math class for a typical assignment?

(1) ____ none
(2) ____ 1-5 min.
(3) ____ 6-10 min.
(4) ____ 11-15 min.
(5) ____ 16-20 min.
(6) ____ 21-25 min.
(7) ____ 26-30 min.
(8) ____ 31-35 min.
(9) ____ 36 min. or more

63. In which type of organization do you teach mathematics?

(1)_____ to one group of pupils (even if split grade) in a self-contained classroom

(2)_____ to several classes or grade levels in a departmentalized organization

(3)_____ other

Answer questions 64 and 65 by writing appropriate numerals in the blanks in the right margin.

64. To how many pupils do you teach mathematics below grade 9? _____

65. To how many classes do you teach mathematics below grade 9? (Consider a group of pupils who are in your class at the same time as a single class, even if it consists of pupils in two grade levels, as with split classes.) _____

APPROVED FORM
DS-PE-008
E. A. COX, Commissioner

PUPIL QUESTIONNAIRE

School Number: _____

1. Circle the numeral in the right margin that shows the grade you are in this year.	5 6 7 8
2. Did you attend nursery school or Head Start before entering kindergarten or first grade? (Circle "Yes" or "No" in the right margin.)	Yes No
3. Did you attend kindergarten before entering first grade? (Circle "Yes" or "No" in the right margin.)	Yes No
4. Have you ever repeated a grade (or grades) because you were not promoted to the next grade? Circle "Yes" or "No" in the right margin and put a check (✓) in the blank in front of each numeral that shows a grade you have repeated.	Yes No

_____1 _____2 _____3 _____4 _____5 _____6 _____7 _____8

MY MATH CLASS

Below are several statements having to do with math classes and math teachers. Read each statement and think about how well the statement describes your math class or your math teacher. Then circle the numeral in the right margin to tell how much you agree or disagree with the statement. Use the following code:

1 - I disagree A LOT
2 - I disagree A LITTLE
3 - I am not sure
4 - I agree A LITTLE
5 - I agree A LOT

SAMPLE

The person in charge will help you get started by explaining how to do the sample items below.

Sample Statements	Disagree				Agree
a. I would be happy if my teacher gave the class no homework on my birthday.	1	2	3	4	(5)
b. I would be happy if my teacher gave us lots of homework every weekend.	(1)	2	3	4	5
c. Broccoli is a tasty vegetable.	1	2	3	4	5
d. I like days that are hot and sunny.	1	2	3	4	5
e. I like days when the snow is so deep that schools are closed.	1	2	3	4	5

Do not begin marking the statements below until you are sure you know how to mark the sample items above. Remember, there are no right or wrong answers. How you mark each statement depends only on how much you agree or disagree with the statement.

Statements	Disagree				Agree
5. If I have trouble with something in math, my teacher makes sure I get the help I need to understand it.	1	2	3	4	5
6. If I have trouble with something in math, my teacher says or does something that makes me want to keep trying and not give up.	1	2	3	4	5
7. When I do well at something in math, my teacher says something about it so that my classmates hear it.	1	2	3	4	5

Statements	Disagree				Agree
8. If I do not know the answer to a math question right away, my teacher gives me time and helps me think before asking somebody else to answer the question.	1	2	3	4	5
9. If I do not know how to answer a math question right away, my teacher asks somebody else to answer before I've had enough time to think of an answer.	1	2	3	4	5
10. My math teacher asks questions about things I have learned by heart (memorized).	1	2	3	4	5
11. My teacher asks questions in math that make me do a lot of thinking about how to solve problems.	1	2	3	4	5
12. My teacher is just as interested in how I solve math problems as in my getting the right answer.	1	2	3	4	5
13. From things my teacher says and does, I know that my teacher really enjoys teaching math.	1	2	3	4	5
14. My math teacher likes me even when I do not do my very best in math.	1	2	3	4	5
15. My teacher usually teaches different things in math class to different pupils.	1	2	3	4	5
16. My teacher usually teaches the same thing to everyone in the class during a math class.	1	2	3	4	5
17. My teacher usually gives the same homework assignment in math to everyone in the class.	1	2	3	4	5
18. My teacher often gives different homework assignments in math to different pupils.	1	2	3	4	5
19. My math class goes over new things so fast that I often have trouble keeping up and understanding what I should learn.	1	2	3	4	5
20. I could learn much more math if my class studied more new things and did not spend so much time drilling on things that I already know.	1	2	3	4	5
21. My math teacher tries to help me understand how math is needed and used in everyday life.	1	2	3	4	5
22. My teacher often tells us to think about whether the answer to a math problem is reasonable.	1	2	3	4	5
23. My teacher usually checks my math homework and marks the problems that I get right or wrong.	1	2	3	4	5
24. My teacher usually checks my homework just to see if I have completed the assignment.	1	2	3	4	5

Statements	Disagree				Agree
25. My teacher gives a math homework assignment almost every day.	1	2	3	4	5
26. If I didn't do a math homework assignment, my teacher would surely know it.	1	2	3	4	5
27. My teacher often assigns extra math problems to pupils who misbehave.	1	2	3	4	5
28. My teacher lets us do most of our math homework during math class.	1	2	3	4	5
29. My teacher often lets pupils in my class exchange papers and correct each others' math homework as we go over the assignment in class.	1	2	3	4	5
30. My teacher often lets us correct our own homework as we go over the assignment in class.	1	2	3	4	5
31. I want to learn as much math as I can and as well as I can.	1	2	3	4	5
32. I want to get good grades in math.	1	2	3	4	5
33. I don't really care about my grades in math.	1	2	3	4	5

ME, MY CLASSMATES, MY PARENTS

Below are several statements having to do with you, your classmates, and your parents. Read each statement and think about how well it describes you, or your classmates, or your parents (or an adult in your home). Then circle a numeral in the right margin, just as you did before, to tell how much you agree or disagree with the statement. Use the same code as before:

1 - I disagree A LOT
2 - I disagree A LITTLE
3 - I am not sure
4 - I agree A LITTLE
5 - I agree A LOT

Statements	Disagree				Agree
34. If I wanted to have my homework checked to see if I had done it correctly, someone at home would be able to check it for me.	1	2	3	4	5
35. If I wanted to have my homework checked to see if I had done it correctly, someone at home would be willing to check it for me.	1	2	3	4	5
36. If I should need help with my math homework, someone at home would be able to help me.	1	2	3	4	5
37. If I should need help with my math homework, someone at home would be willing to help me as much as they can.	1	2	3	4	5
38. My parents are interested in knowing that I've done my best to complete my math homework.	1	2	3	4	5
39. My parents expect more of me in math than I can really do.	1	2	3	4	5
40. My parents don't care what grades I get in math so long as I pass.	1	2	3	4	5
41. My parents are interested in knowing how I do on math quizzes and tests.	1	2	3	4	5
42. My parents don't really care if I pass or fail in math.	1	2	3	4	5
43. My classmates respect and look up to kids who do well in math.	1	2	3	4	5
44. My classmates look down on or make fun of kids who do well in math.	1	2	3	4	5
45. Math is one of my most favorite subjects.	1	2	3	4	5
46. Math is one of my least favorite subjects.	1	2	3	4	5